Radiological Health Data

VOLUME III, NUMBER 8

AUGUST 1962

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis and interpretation of data on environmental radiation levels. The Department delegated this responsibility to the Division of Radiological Health, Public Health Service.

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RADIOLOGICAL HEALTH DATA

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service • Division of Radiological Health

ADVANCE REPORT

The Public Health Service Pasteurized Milk Network July monthly tabulations of 61 stations show an average daily iodine-131 concentration of 40 micromicrocuries per liter during July. Monthly average concentrations of more than 20 μμc/liter were noted at 21 stations. Of the 61 stations, only 2 averaged more than 80 μμc/liter per day. These were Salt Lake City with 580 μμc/liter and Laramie, Wyoming, with 370 μμc/liter. These elevated levels of iodine-131 occurred during the last 3 weeks of July with a daily high value of 2,050 μμc/liter in Salt Lake City on July 25.

As a precaution against possible continued high iodine-131 levels, Salt Lake City and State of Utah health officials, working with the dairy industry, initiated limited control measures through management of the milk supply on August 1. The situation will permit them to determine the effectiveness of controlling the general iodine levels by diverting milk from parts of the milkshed with highest iodine-131 levels into manufactured milk products and milk from milksheds with lower iodine levels into the pasteurized fluid milk used daily in the Salt Lake City area.

Editor's note: The above information is preliminary and subject to further confirmation. It summarizes recent data submitted to the Radiation Surveillance Center, Division of Radiological Health, Public Health Service.

SECTION I.—AIR AND PRECIPITATION

Fission Product Beta Activity in Airborne Particulates and Precipitation

Measurements of gross beta activity of airborne particulates and precipitation are among the earliest and most sensitive indicators of increases of fission product activity in the environment. However, a direct evaluation of biological effects is not possible from these data alone.

Of the several networks or sampling programs making such measurements the Radiation Surveillance Network and the Naval Research Laboratory are represented in the following reports.

RADIATION SURVEILLANCE NETWORK
May 1962

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network (RSN) was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increasing levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, the Network consisted of 45 stations. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the Network has been expanded over a period of several months to 72 stations, whose locations are shown in figure 1.

Air

Daily 24-hour air samples are collected by a high volume air sampler with a 4-inch diameter carbon-loaded cellulose dust filter. Field measurements with a portable survey meter enable the station operator to estimate the amount of beta activity in airborne particulates at the station five hours after collection by comparison with a known Sr^{90}–Y^{90} source. This 5-hour delay eliminates interference from naturally-occurring radon daughters. Each operator then reports his field estimate by telephone to the Radiation Surveillance Center, Division of Radiological Health in Washington, D. C., to provide a daily national alert report.

The filters are then forwarded to the Radiation Surveillance Network Laboratory in Rockville, Maryland, for a more refined measurement using a thin-window gas-flow proportional counter. Each filter is counted at least three days after the end of the sampling period and re-counted seven days later. The initial three-day aging of the sample eliminates interference from naturally-occurring radon and

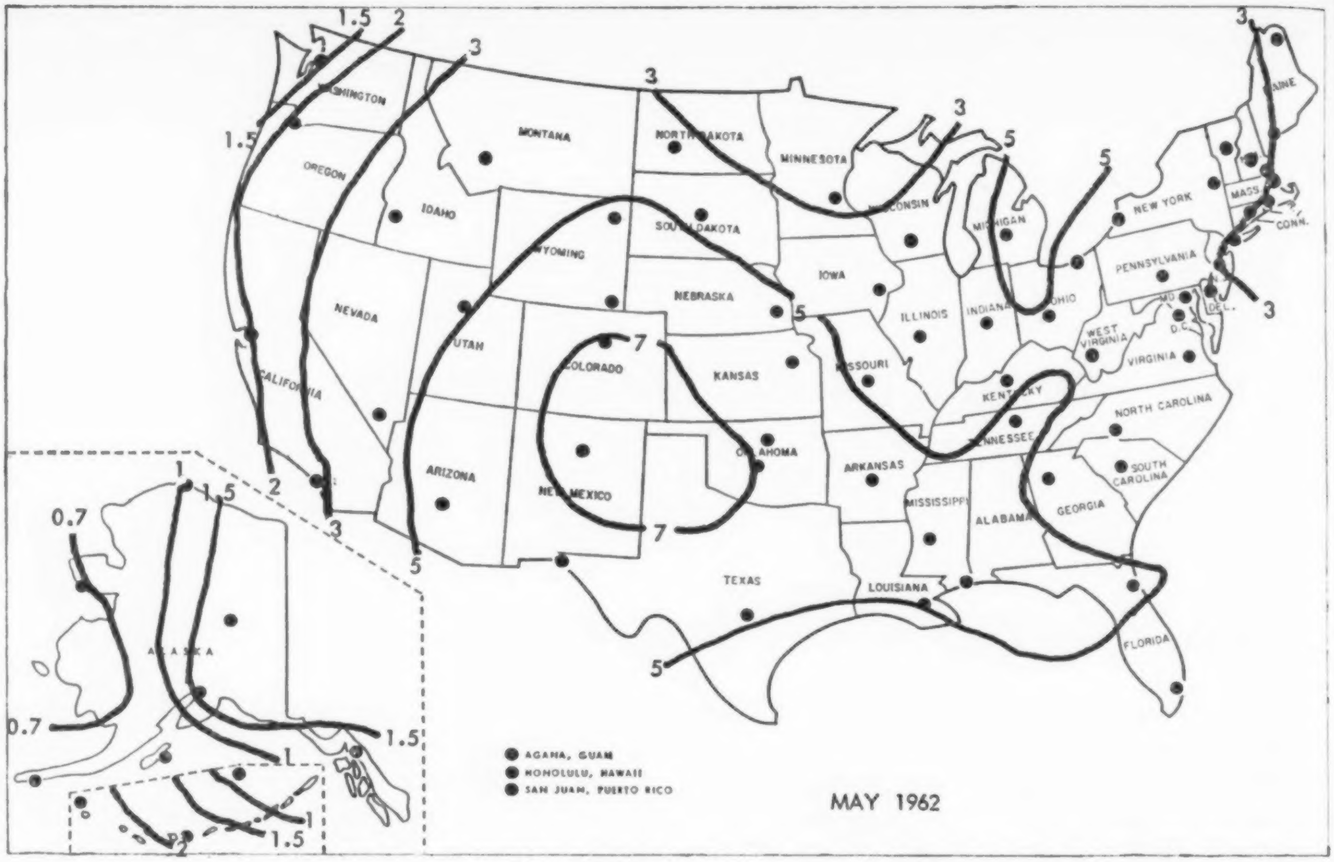

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS AND AVERAGE FISSION PRODUCT BETA CONCENTRATIONS IN AIR ($\mu\mu c/m^3$) MAY 1962

thoron daughters. The two counts, separated by a seven-day interval, make possible the estimation of an effective age of fission products and extrapolation of the activity to the time of collection. The extrapolation is performed by using the Way-Wigner formula ($AT^{1.2} =$ constant).*

The average fission-product beta concentrations in surface air during May 1962 as determined by laboratory analysis are tabulated in table 1 and presented by means of iso-concentration contours in figure 1. Experience has shown that field estimates are generally comparable to laboratory analyses, except at low levels, where the former are usually higher because of natural radon and thoron daughters.

Precipitation

Continuous sampling for total precipitation is conducted at most stations on a daily basis using funnels having collection areas of 0.4 square meter. A 500-ml aliquot of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples. If the collected sample is between 200 and 500 ml, the entire sample is evaporated; if less than 200 ml, the volume of precipitation is reported, but no analysis is made.

The May 1962 averages of gross beta activity in precipitation, expressed in micromicrocuries per liter ($\mu\mu c$/liter) and micromicrocuries per square meter ($\mu\mu c/m^2$) are presented in table 2. Placement of a "less than" sign (<) with an average concentration or total deposition value indicates that the sum of the "less than" daily deposition values is 10% or more of the total deposition so that the true total or average is considered significantly less than the value shown.

Profiles

The profiles of the monthly average fission product beta activity in airborne particulates for each RSN station covering the period of time from the formation of the network in 1956 to the end of 1960 were published in *RHD*, July 1961. The profiles of seven stations, updated through May 1962, are shown in figure 2.

* In this expression, A is the activity at time T after fission product formation. Units are arbitrary.

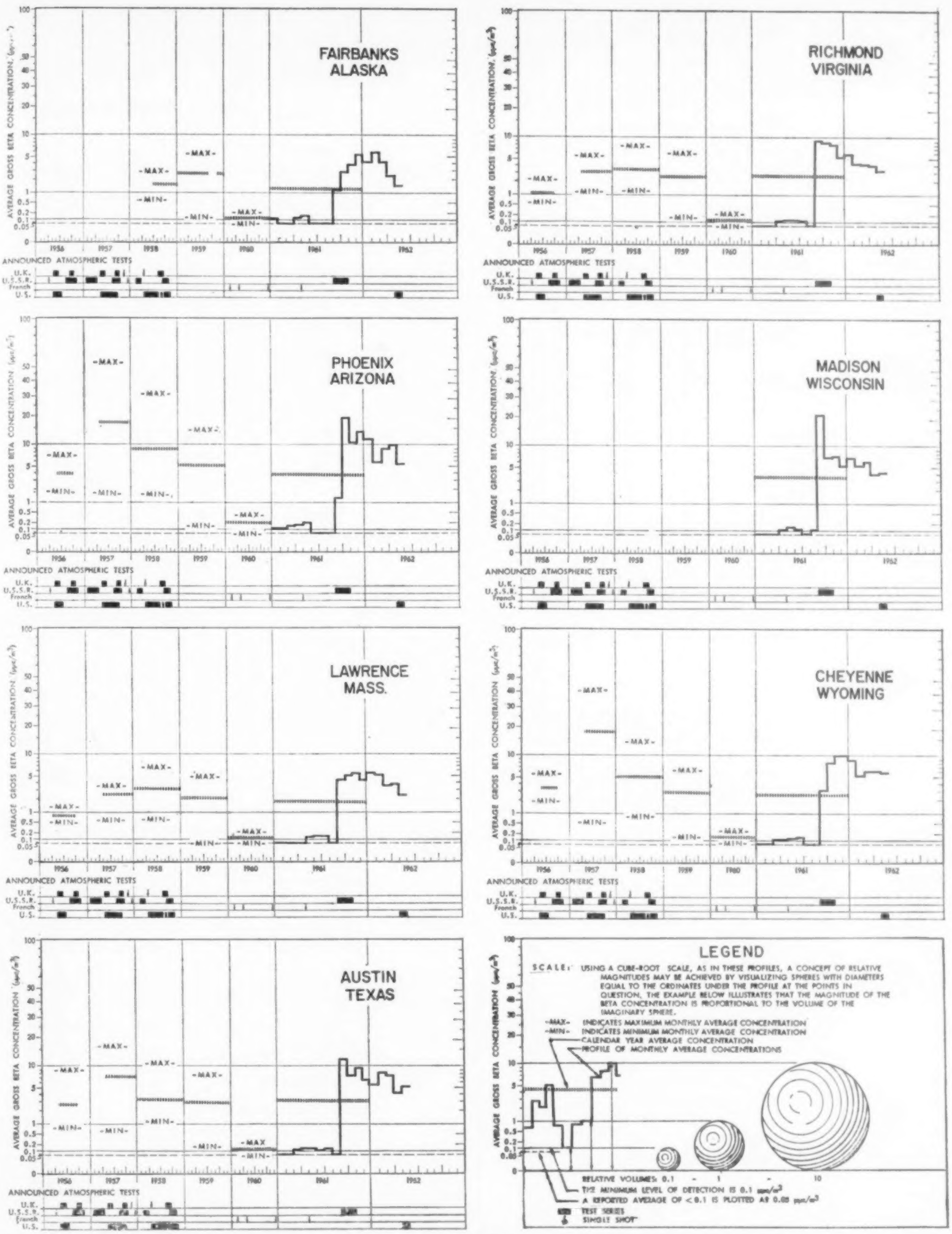

FIGURE 2.—MONTHLY AND YEARLY PROFILES OF BETA ACTIVITY IN AIR, RADIATION SURVEILLANCE NETWORK, 1956–MAY 1962

Table 1.—GROSS BETA ACTIVITY OF PARTICULATES IN AIR, RSN, MAY 1962

[Concentrations in $\mu\mu c/m^3$]

Station location		Number samples	Maximum	Minimum	Average*	Station location		Number samples	Maximum	Minimum	Average*
City	State					City	State				
Adak	Alaska	31	6.2	0.15	1.6	Jackson	Miss	31	8.3	2.4	5.6
Anchorage	Alaska	31	3.5	0.12	1.6	Pascagoula	Miss	23	9.6	2.7	6.6
Attu	Alaska	33	9.5	0.35	2.6	Jefferson City	Mo	31	6.1	1.9	4.6
Cold Bay	Alaska	3	3.0	2.6	2.8	Helena	Mont	31	8.4	0.15	3.4
Fairbanks	Alaska	31	4.1	<0.10	1.6	Lincoln	Nebr	30	8.6	2.3	5.5
Juneau	Alaska	23	3.0	<0.10	1.4	Las Vegas	Nev	20	9.0	2.8	4.8
Kodiak	Alaska	28	2.4	<0.10	0.88	Concord	N. H	22	8.0	0.22	3.9
Nome	Alaska	17	1.6	<0.10	0.70	Trenton	N. J	30	5.1	0.27	2.7
Point Barrow	Alaska	25	1.8	0.38	1.0	Santa Fe	N. Mex	31	15.0	3.3	7.8
St Paul Island	Alaska	31	2.2	<0.10	0.73	Albany	N. Y	31	7.3	0.22	3.6
Phoenix	Ariz	30	9.5	2.0	5.6	Buffalo	N. Y	31	10.0	1.8	4.6
Little Rock	Ark	30	7.8	3.0	5.4	New York	N. Y	17	5.0	0.72	2.9
Berkeley	Calif	30	3.7	0.56	2.0	Gastonia	N. C	31	6.6	2.1	4.4
Los Angeles	Calif	26	6.6	0.84	2.9	Bismark	N. D	30	7.4	0.64	3.0
Denver	Colo	30	31.0	1.0	7.4	Columbus	Ohio	29	7.9	1.9	4.6
Hartford	Conn	31	5.0	0.29	3.0	Painesville	Ohio	31	6.3	0.76	3.8
Dover	Del	17	5.4	2.3	4.0	Oklahoma City	Okla	31	13.0	3.3	7.0
Washington	D. C	31	4.7	0.25	3.3	Ponca City	Okla	31	4.6	1.2	2.8
Jacksonville	Fla	31	7.6	2.5	5.0	Portland	Oreg	30	6.3	0.24	2.5
Miami	Fla	29	6.6	2.1	4.5	Harrisburg	Pa	29	9.5	0.43	4.6
Atlanta	Ga	28	6.7	1.2	3.6	San Juan	P. R	20	4.5	0.96	2.5
Agana	Guam	22	5.0	0.42	2.3	Providence	R. I	28	6.1	0.14	2.7
Honolulu	Hawaii	29	2.7	0.45	1.3	Columbia	S. C	29	6.2	2.1	3.5
Boise	Idaho	29	7.8	<0.10	3.7	Pierre	S. D	31	7.2	0.43	3.3
Springfield	Ill	31	6.4	1.8	3.9	Nashville	Tenn	31	8.9	2.2	5.4
Indianapolis	Ind	31	6.0	1.9	4.0	Austin	Tex	29	9.7	2.8	5.4
Iowa City	Iowa	31	7.0	1.3	3.8	El Paso	Tex	30	11.0	2.8	5.6
Topeka	Kans	30	10.0	2.1	5.3	Salt Lake City	Utah	30	14.0	0.26	4.3
Frankfort	Ky	28	7.1	1.7	3.8	Barre	Vt	31	7.5	0.16	4.1
New Orleans	La	31	7.0	1.9	5.0	Richmond	Va	31	4.6	0.43	3.1
Augusta	Maine	30	5.9	0.31	2.9	Seattle	Wash	30	3.1	0.38	1.1
Presque Isle	Maine	31	5.2	0.57	2.7	Charleston	W. Va	23	5.6	2.1	3.9
Baltimore	Md	31	6.6	0.54	4.0	Madison	Wis	30	7.9	0.84	4.2
Lawrence	Mass	30	5.7	0.16	2.5	Cheyenne	Wyo	30	18.0	1.4	6.0
Winchester	Mass	30	5.1	0.19	2.5	Sundance	Wyo	24	18.0	0.62	5.1
Lansing	Mich	31	9.0	2.9	5.5						
Minneapolis	Minn	31	3.4	0.35	2.9	Network average					3.70

* Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

Table 2.—GROSS BETA RADIOACTIVITY IN PRECIPITATION, MAY, 1962

Station location		Rainfall (millimeters)	Deposition ($\mu\mu c/m^2$)	Station location		Rainfall (millimeters)	Deposition ($\mu\mu c/m^2$)
City	State			City	State		
Adak	Alaska	[a] —	—	Minneapolis	Minn	160.36	200,000
Anchorage	Alaska	16.89	12,000	Jackson	Miss	—	—
Attu	Alaska	—	—	Pascagoula	Miss	—	—
Cold Bay	Alaska	—	—	Jefferson City	Mo	49.07	250,000
Fairbanks	Alaska	—	—	Helena	Mont	33.50	94,000
Juneau	Alaska	53.50	34,000	Lincoln	Nebr	48.70	75,000
Kodiak	Alaska	—	—	Las Vegas	Nev	—	—
Nome	Alaska	—	—	Concord	N. H	—	—
Point Barrow	Alaska	—	—	Trenton	N. J	3.92	5,000
St. Paul Island	Alaska	—	—	Albany	N. Y	29.88	41,000
Phoenix	Ariz	—	—	Buffalo	N. Y	38.37	22,000
Little Rock	Ark	31.25	62,000	New York	N. Y	—	—
Berkeley	Calif	—	—	Gastonia	N. C	23.45	46,000
Los Angeles	Calif	—	—	Bismarck	N. Dak	138.26	260,000
Denver	Colo	4.65	18,000	Columbus	Ohio	78.66	160,000
Hartford	Conn	32.98	69,000	Painesville	Ohio	43.56	80,000
Dover	Del	—	—	Oklahoma City	Okla	30.00	<11,000
Washington	D. C	45.51	60,000	Ponca City	Okla	51.31	57,000
Jacksonville	Fla	15.10	31,000	Portland	Oreg	49.32	31,000
Miami	Fla	—	—	Harrisburg	Penn	31.22	39,000
Atlanta	Ga	12.50	24,000	San Juan	P. R	—	—
Agana	Guam	—	—	Providence	R. I	43.25	65,000
Honolulu	Hawaii	8.00	3,800	Columbia	S. C	33.97	74,000
Springfield	Ill	96.25	81,000	Pierre	S. Dak	131.90	150,000
Indianapolis	Ind	163.40	340,000	Nashville	Tenn	20.20	23,000
Iowa City	Iowa	176.57	380,000	Austin	Tex	17.50	<6,100
Topeka	Kans	71.47	390,000	El Paso	Tex	—	—
Frankfort	Ky	70.07	150,000	Salt Lake City	Utah	63.40	110,000
New Orleans	La	25.50	54,000	Barre	Vt	—	—
Augusta	Maine	59.14	73,000	Richmond	Va	70.75	92,000
Presque Isle	Maine	29.70	40,000	Seattle	Wash	38.72	60,000
Baltimore	Md	7.50	6,300	Charleston	W. Va	52.23	100,000
Lawrence	Mass	50.70	73,000	Madison	Wis	65.10	240,000
Winchester	Mass	47.73	61,000	Cheyenne	Wyo	56.70	54,000
Lansing	Mich	45.61	77,000	Sundance	Wyo	—	—

[a] Dash denotes no sample received.

THE 80TH MERIDIAN (WEST) SAMPLING PROGRAM
April 1962

U.S, Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian (West) have been made since 1956. Sampling locations are shown in figure 3. This program is operated by the U. S. Naval Research Laboratory (NRL) with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile, which collect the samples and forward them to NRL for analysis. Partial financial support of this program is provided by the Division of Biology and Medicine, U. S. Atomic Energy Commission.

The sampling procedure involves drawing air continuously for a seven-day period, at a rate of approximately 1200 cubic meters per day through a high efficiency filter, 8 inches in diameter, using a positive displacement blower. After the 7-day period, the filter is removed and forwarded to NRL for assay of gross beta activity. A minimum of 2 weeks after collection is allowed for decay of short-lived radionuclides. Data are not extrapolated to time of collection.

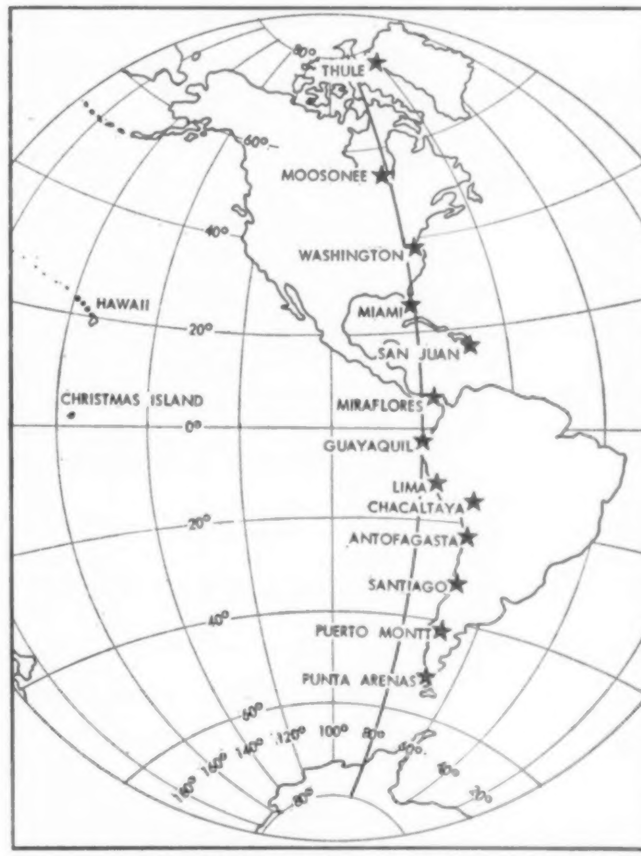

FIGURE 3.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

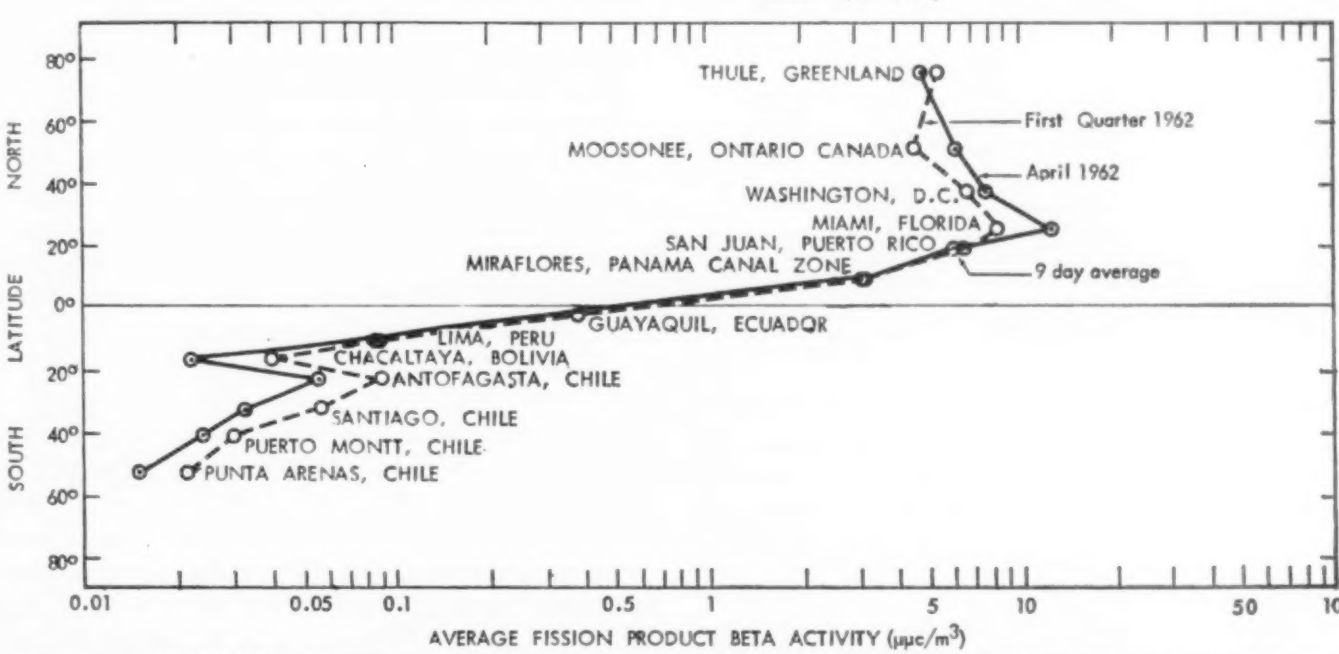

FIGURE 4.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST), APRIL 1962

TABLE 3.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NRL, APRIL, 1962[a]

[Average concentrations in $\mu\mu c/m^3$][b]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	San Juan, P. R.	Mauna Loa, Hawaii[c]	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1–2	0.014	0.030	0.039	0.068	0.014	0.098	0.156	3.20	6.08	8.91	10.4	11.0	4.77	4.59
3–9	0.019	0.023	0.028	0.041	0.012	0.128	[d]—	3.50	6.08	3.62	10.3	8.55	5.44	7.42
10–16	0.013	0.017	0.038	0.056	0.023	0.071	—	3.58	—	5.44	12.4	4.77	8.42	4.68
17–23	0.014	0.031	0.032	0.055	0.019	0.083	—	3.58	—	4.86	12.4	7.38	5.18	4.54
24–30	0.015	—	0.032	0.052	0.036	0.067	—	1.81	—	2.85	16.8	9.68	6.03	2.28
Weighted average	0.015	0.024	0.033	0.053	0.022	0.088	—	3.12	—	4.50	12.8	7.83	6.16	4.82

[a] The average concentration determined from a given sample is placed at the center of a rectangle which indicates the length and dates of the sampling period. Station averages for the month were determined by weighting the sample averages according to the number of days in the sampling period or that portion of the sampling period occurring in April 1962.

[b] Note: In the May and June issues, the corresponding units are incorrectly given in $\mu\mu c$/liter; the appropriate units are given above.

[c] Mauna Loa data has been included for comparison which Chacaltaya, Bolivia. Both are high elevation stations (3,400 and 5,200 meters) and about equally distant north and south of the equator.

[d] Dash indicates sample was not received.

Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio, April 23–May 18, 1962

Division of Radiological Health, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon–222) and thoron (radon–220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon and its daughters. Thoron and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program at Cincinnati for radon, thoron, and gross beta fission product concentrations in surface air. The airborne particulates, which include the daughter products of radon and thoron, are collected continuously on a membrane filter surface at a rate of approximately 1.2 cubic meters of air per hour.

Radon–222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon–222 (a.m.) concentrations have been corrected for any radon–220 daughter interferences. Radon–222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon–222 (p.m.) concentrations are uncorrected for any radon–220 daughter interferences. Radon–220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon–222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter. The gross beta activity of airborne particulates, when measured several days after sample collection, is due principally to artificially-produced fission products.

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, APRIL 23–MAY 18, 1962

End of sampling period	Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m. ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
April 23	220	80	4.4	10.7
24	670	70	7.6	7.8
25	870	120	11.4	8.6
26	840	110	11.3	11.8
27	820	100	11.6	13.4
30	420	90	8.3	2.8
May 1	70	60	1.5	6.9
2	80	40	0.7	3.6
3	320	60	2.5	7.3
4	660	70	4.8	8.1
7	230	80	5.4	10.2
8	240	150	5.2	6.9
9	140	130	3.1	5.2
10	320	150	5.6	5.6
11	380	120	3.9	8.4
14	590	110	6.1	9.4
15	710	100	7.1	9.0
16	1030	120	9.1	8.4
17	350	170	10.1	7.4
18	1150	190	11.4	8.1
Average	465	101	6.4	8.1
Range of counting errors (2σ):				
Maximum	60	24	1.1	0.22
Minimum	15	11	0.3	0.06

The data are computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the period April 23–May 18, 1962 appear in table 1.

REFERENCE

Setter, L. R. and G. I. Coats "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal, 22:* 64–9 (February 1961).

SECTION II.—FOOD

Strontium–90 in Raw Foods

Pharmacology Division
Food and Drug Administration

The Food and Drug Administration (FDA) conducts a sampling program to determine the concentrations of certain radionuclides in a variety of different domestic and foreign food items, as well as in animal feeds and other items which may be of importance in the food chain. Most of the domestic products examined for strontium-90 content are raw, unwashed, and unprocessed, and are collected by FDA inspectors, either directly from individual growers or from storage sheds where products are assembled before shipment. Collection records kept by the inspectors include date of collection, date of harvest, date of planting, name of grower or growers, location of farm by county or State, and name and location of marketing cooperative or dealer. When manufactured items are collected, information on the source of the raw materials is recorded.

Although samples are not collected according to a regular schedule or fixed geographical grid, the major growing areas for all of the products are sampled at intervals which usually coincide with harvest dates for the specific crop. Decisions as to what products to sample, sampling intervals, and assigned priorities are reviewed annually and incorporated into a surveillance program which is continually adjusted to cover special fallout situations associated with worldwide nuclear weapons testing. The current program comprises collection of 3500 single samples representing 50 categories of domestic, foreign, and animal foods and analysis for strontium-90. Limited analyses for cesium-137 and iodine-131 are done by gamma spectrometry.

Currently, the method used by the FDA laboratories for the analysis of strontium-90 is a modification of that outlined in the *HASL Manual of Standard Procedures* (*1*), and involves ashing the food at 550 to 600° C, dissolving the ash in hydrochloric acid, precipitating strontium and calcium as oxalates, and separating the strontium from the calcium in concentrated nitric acid. After the radium and lanthanides are scavenged with barium chromate, strontium is determined either by isolation and measurement of the daughter product yttrium-90 after secular equilibrium has been established or by direct measurement as strontium-90 with correction for ingrowth of yttrium-90. The latter method is the procedure of choice because it obviates the 3-week delay period necessary for ingrowth of yttrium-90. It also determines strontium-89, which renders this latter method currently not applicable.

1. Pacific .... California, Idaho, Nevada, Oregon, Washington
2. Rocky Mountain .... Colorado, Montana, Utah, Wyoming
3. Southwest .... Arizona, New Mexico, Oklahoma, Texas
4. North Central .... Kansas, Minnesota, Nebraska, North Dakota, South Dakota
5. Great Lakes .... Michigan, Wisconsin
6. Mid Central .... Arkansas, Illinois, Iowa, Missouri
7. East Central .... Indiana, Kentucky, Ohio

[Continued on page 284]

TABLE 1.—GEOGRAPHICAL DISTRIBUTION OF STRONTIUM-90 IN VARIOUS RAW FOODS

Raw food and zone	Pre-test			Post-test		
	No. of samples	Mean (μμc/kg)	Standard deviation of mean	No. of samples	Mean (μμc/kg)	Standard deviation of mean
Cabbage						
West	2	5.3	1.7	4	3.6	1.0
Central	1	6.0	*—	9	5.0	0.9
East	1	23	—	5	13	3
Carrots						
West	10	3.3	0.7	8	3.4	0.7
Central	6	5.0	1.8	5	8.8	3.6
East	7	11	3	4	21	2
Celery						
West	7	3.7	0.9	4	9.3	2.6
Central	10	5.8	1.1	0		
East	1	3.7	—	3	16	11
Lettuce						
West	10	2.1	0.4	14	19	10
Central	10	4.0	1.5	3	4.4	0.8
East	0			1	13	—
Lima Beans (bean)						
West	0			3	3.0	1.9
Central	6	8.2	2.2	2	1.5	0.2
East	5	12	4	3	6.2	1.7
Lima Beans (pod)						
West	0			3	9.3	3.3
Central	6	35	5	2	49	38
East	5	67	25	3	57	7
Onions						
West	7	4.3	1.2	5	7.2	1.6
Central	7	2.3	0.6	1	6.4	—
East	1	0.3	—	1	6.4	—
Potatoes						
West	2	1.2	0.6	15	1.6	0.3
Central	7	2.8	1.4	7	1.6	0.4
East	0			11	1.7	0.2
Root vegetables						
West	2	11	2	7	4.7	1.0
Central	0			6	27	12
East	1	24	—	6	22	6
Snap Beans						
West	11	5.2	1.1	3	3.1	0.5
Central	20	28	6	2	3.9	0.9
East	16	26	6	1	10	—
Soy Beans						
West	1	11	—	2	9.1	1.0
Central	0			9	23	4
East	0			3	96	15
Spinach						
West	11	5.0	0.5	0		
Central	4	48	6	0		
East	0			8	24	3
Tomatoes						
West	8	0.8	0.3	6	0.9	0.4
Central	10	0.5	0.1	1	0.5	—
East	4	1.1	0.1	8	2.6	0.5
Miscellaneous vegetables						
West	0			14	62	15
Central	4	4.2	1.0	1	3.9	—
East	0			15	19	6
Apples						
West	7	0.4	0.1	8	0.4	0.0
Central	4	1.3	0.1	2	1.5	0.2
East	1	2.6	—	15	0.2	0.2
Peaches						
West	7	0.8	0.2	1	2.2	—
Central	4	1.4	0.1	0		
East	5	1.7	0.2	0		
Strawberries						
West	10	2.2	0.6	0		
Central	14	20	2	0		
East	14	11	2	0		
Miscellaneous fruit						
West	1	1.3	—	5	12	2
Central	0			4	4.0	2.8
East	0			2	3.0	1.0
Cheddar cheese						
West	3	51	14	2	125	7
Central	14	48	3	1	21	—
East	5	35	8	0		

* Dash indicates that standard deviation cannot be calculated from data.

TABLE 1.—GEOGRAPHICAL DISTRIBUTION OF STRONTIUM-90 IN VARIOUS RAW FOODS—Continued

Raw food and zone	Pre-test			Post-test		
	No. of samples	Mean (μμc/kg)	Standard deviation of mean	No. of samples	Mean (μμc/kg)	Standard deviation of mean
Egg shell						
West	2	347	146	0		
Central	3	646	335	1	386	—
East	0			0		
Egg substance						
West	3	2.9	0.3	0		
Central	5	2.1	0.5	0		
East	0			2	2.3	1.0
Evaporated milk						
West	4	7.7	4.4	0		
Central	10	21	5	0		
East	2	24	0	0		
Corn grain & Corn meal						
West	4	1.1	0.3	2	0.3	0.0
Central	6	3.5	1.1	2	0.4	0.4
East	7	1.3	0.4	2	0.1	0.1
Rice						
West	6	1.1	0.4	0		
Central	1	1.3	—	8	4.2	1.2
East	0			0		
Rye						
West	2	12	2	0		
Central	2	19	4	0		
East	2	25	0	0		
Wheat						
West	10	12	4	2	2.2	0.3
Central	8	25	6	0		
East	9	28	5	2	12	6
Albacore						
Spain	0			1	0.3	—
Bonita						
Lima, Peru	0			5	0.3	0.2
Haddock (fillet)						
Massachusetts	1	0.1	—	1	0.2	—
Haddock (skin on)						
Massachusetts	1	0.2	—	0		
Georges Bank	0			1	0.2	
Sardines						
Maine, USA	0			3	0.8	0.3
Tuna						
Japan	1	0.1	—	4	0.2	0.1
Portugal	0			1	1.7	—
Almonds						
California, USA	1	0.7	—	0		
Cashews						
Mozambique	0			1	0.0	—
Peanuts						
New Mexico, USA	0			5	14	0.8
Texas, USA	0			1	87	—
Virginia, USA	0			1	6.8	—
Pecans						
New Mexico, USA	0			1	19	—
Oklahoma, USA	0			2	5.4	2.1
Texas, USA	0			1	4.3	—
Georgia, USA	2	12	1	0		
Cocoa Beans						
Ivory Coast	0			1	25	—
Cameroun	0			1	20	—
Angola	1	14	—	0		
Dominican Republic	0			1	18	—
Coffee Beans						
Ivory Coast	1	43	—	0		
British East Africa	1	16	—	0		
Mexico	1	22	—	2	25	0
Tea						
Africa	4	35	10	2	98	55
S. America	4	111	41	0		
Far East	20	328	75	22	357	87

* Dash indicates that standard deviation cannot be calculated from data.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS

Raw food	Origin: Harvest region	Origin: State or country	Origin: County	Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
Vegetables					
Beans, lima					
Bean	1	Calif.	Monterey	Oct. 1961	6.7*
Pod				Oct. 1961	9.2*
Bean			Santa Clara	Oct. 1961	0.6*
Pod				Oct. 1961	3.8*
Bean				Oct. 1961	1.6*
Pod				Oct. 1961	15*
Bean	5	Wis.	Calumet	Aug. 1961	4.2
Pod				Aug. 1961	44
Bean			Waushara	Aug. 1961	5.4
Pod				Aug. 1961	46
Bean				Aug. 1961	7.1
Pod				Aug. 1961	11
Bean				Aug. 1961	6.8
Pod				Aug. 1961	39
Bean	6	Ill.	DeKalb	Aug. 1961	6.6
Pod				Aug. 1961	30
Bean				Aug. 1961	19
Pod				Aug. 1961	41
Bean			Ogle	Sept. 1961	1.7
Pod				Sept. 1961	88
Bean				Sept. 1961	1.2
Pod				Sept. 1961	11
Bean	9	N. C.	Henderson	Sept. 1961	2.7
Pod				Sept. 1961	43
Bean	10	Del.	Kent	Aug. 1961	12
Pod				Aug. 1961	46
Bean				Sept. 1961	8
Pod				Sept. 1961	64
Bean	10	N. J.	Burlington	Aug. 1961	5.6
Pod				Aug. 1961	44
Bean			Camden	Aug. 1961	27
Pod				Aug. 1961	160
Bean			Cumberland	Aug. 1961	12
Pod				Aug. 1961	68
Bean	11	Pa.	Bucks	Aug. 1961	3.3
Pod				Aug. 1961	17
Bean			York	Sept. 1961	8.0
Pod				Sept. 1961	64
Beans, snap	1	Calif.	Monterey	Sept. 10, 1960	2.0
			San Benito	Sept. 14, 1960	2.4
			Sonoma	Aug. 15, 1961	2.9
			Santa Cruz	Aug. 15, 1961	2.9
				Sept. 6, 1961	2.9
				Oct. 1, 1961	3.5*
				Oct. 1, 1961	2.3*
				Oct. 4, 1961	3.5*
	1	Wash.	King	Sept. 13, 1961	5.1
	2	Colo.	Weld	Sept. 6, 1960	10
				Aug. 10, 1961	4.2
				Aug. 21, 1961	5.0
			Montrose	Aug. 3, 1961	14
	2	Utah	Davis	Aug. 21, 1961	6.0
	3	Okla.	Adair	June 28, 1961	37
	3	Tex.	Hidalgo	Nov. 16, 1960	3.9
			Cameron	Nov. 21, 1961	4.7*
	5	Mich.	Tuscola	Aug. 16, 1960	8.8
			Delta	Aug. 17, 1960	4.0
				Aug. 24, 1961	6.9
			Sanilac	Aug. 17, 1960	11
				Aug. 16, 1961	2.9
			Van Buren	Aug. 22, 1960	40
	5	Wis.	Calumet	Aug. 31, 1961	2.4
			Waushara	Aug. 31, 1961	27
				Aug. 31, 1961	40
				Aug. 31, 1961	22
	6	Ark.	Benton	Sept. 16, 1960	27
				Sept. 16, 1960	89
				Sept. 16, 1960	7
	6	Ill.	Ogle	Aug. 31, 1961	51
				Sept. 1, 1961	40
				Sept. 1, 1961	11
				Sept. 1, 1961	72
	7	Ohio	Mercer	Aug. 16, 1961	4.1
	8	Tenn.	Medina†	Oct. 31, 1961	3.0*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
	Harvest region	State or country	County		
Beans, snap—continued	9	Fla.	Palm Beach	Nov. 15, 1960	3.9
	10	Del.	Sussex	Aug. 24, 1961	36
			Kent	Aug. 30, 1961	36
	10	Md.	Dorchester	Sept. 7, 1960	7.2
				Sept. 7, 1960	14
				Sept. 14, 1960	41
			Worchester	Sept. 19, 1960	98
	10	N. J.	Burlington	Aug. 24, 1961	30*
			Camden	Aug. 24, 1961	14
			Bergen	Oct. 18, 1961	10*
	10	Va.	Shenandoah	Sept. 22, 1960	4.2
	11	N. Y.	Oneida	Sept. 16, 1960	11
			Columbia	Sept. 20, 1960	11
			Wayne	Sept. 22, 1960	46
	11	Pa.	Bucks	Aug. 26, 1961	14
			Cumberland	Aug. 29, 1961	18
			York	Aug. 31, 1961	32
Broccoli					
fresh	1	Calif.	Ventura	Jan. 16, 1962	4.7*
frozen				Jan. 16, 1962	1.6*
fresh			Santa Barbara	Feb. 14, 1962	35*
frozen				Feb. 14, 1962	36*
fresh	10	N. J.	Cumberland	Nov. 8, 1961	14*
frozen				Nov. 8, 1961	10*
fresh	10	Va.	Northampton	Oct. 13, 1961	25*
frozen				Oct. 13, 1961	10*
fresh				Nov. 13, 1961	13*
frozen				Nov. 13, 1961	14*
				Nov. 13, 1961	8.8*
Cabbage	1	Calif.	Ventura	Dec. 15, 1961	4.5*
	1	Idaho	Ada & Canyon	Sept. 7, 1961	3.5
	1	Wash.	Spokane	Oct. 30, 1961	0.7*
			Pierce	Nov. 15, 1961	4.4*
	2	Colo.	Weld	Sept. 6, 1961	7.0
	3	Ariz.	Yuma	Jan. 9, 1962	4.8*
	3	Tex.	Zavala	Nov. 27, 1961	3.1*
			Cameron	Jan. 3, 1962	5.2*
	4	Kans.	Johnson	June 19, 1961	6.0
	5	Mich.	LaPeer	Nov. 3, 1961	2.8*
	5	Wis.	Brown	Nov. 9, 1961	3.8*
			Kenosha	Nov. 9, 1961	3.6*
			Outagamie	Nov. 9, 1961	12*
			Milwaukee	Nov. 10, 1961	4.8*
			Ozaukee	Nov. 10, 1961	3.9*
			Waukesha	Nov. 10, 1961	6.0*
	9	Ga.	Fannin	May 12, 1961	23
	9	N. C.	Pasquotank	Dec. 14, 1961	5.7*
				Dec. 20, 1961	15*
	10	Va.	Floyd	Nov. 7, 1961	26*
			Accomac	Nov. 16, 1961	13*
			Norfolk	Dec. 20, 1961	9.1*
Carrots	1	Calif.	Santa Barbara	Feb. 14, 1961	6.5
			Stanislaus	Feb. 15, 1961	2.0
			San Joaquin	Mar. 1, 1961	2.8
				July 11, 1961	2.5
			Ventura	Mar. 8, 1961	2.4
				Feb. 14, 1962	3.2*
			Orange	May 1, 1961	1.8
			Monterey	July 10, 1961	0.8
			Riverside	Jan. 22, 1962	1.6*
				Jan. 31, 1962	1.3*
	1	Oreg.	Marion	Nov. 1, 1961	3.2*
	1	Wash.	King	Nov. 10, 1960	7.5
			Walla Walla	Nov. 30, 1960	2.8
	2	Colo.	Adams	Sept. 19, 1960	3.6

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
	Harvest region	State or country	County		
Carrots—(continued)	2	Utah	Davis	Oct. 11, 1961	5.4*
			Utah	Oct. 12, 1961	7.1*
			Sevier	Nov. 10, 1961	4.0*
	3	N. Mex.	Valencia	Nov. 25, 1961	1.5*
	3	Tex.	Kinney	Feb. 15, 1961	3.1
			Zavala	Feb. 15, 1961	6.5
			Hidalgo	Mar. 1, 1961	2.6
				Mar. 29, 1961	1.2
			Dimmit	Jan. 1962	0.5*
	4	Minn.	Anoka	Oct. 15, 1961	22*
	5	Mich.	Antrim	Oct. 15, 1960	13
	5	Wis.	Racine	Oct. 27, 1960	3.8
			Sheboygan	Oct. 14, 1961	4.8*
			Washington	Oct. 14, 1961	9.2*
			Manitowoc	Oct. 17, 1961	7.4*
	10	N. J.	Salem	Oct. 10, 1961	18*
				Oct. 17, 1961	25*
				Oct. 24, 1961	21*
				Oct. 31, 1961	21*
	11	N. Y.	Wayne	Oct. 24, 1960	1.7
			Suffolk	Nov. 14, 1960	9.3
			Ontario	Nov. 30, 1960	4.8
	11	Pa.	Bucks	Jan. 9, 1961	19
	12	Mass.	Hampden	Sept. 27, 1960	18
			Essex	Mar. 7, 1961	4.9
	12	R. I.	Kent	Sept. 21, 1960	21
Cauliflower	1	Wash.	King	Nov. 11, 1961	1.5*
	11	N. Y.	Suffolk	Dec. 5, 1961	6.4*
				Dec. 5, 1961	6.6*
				Dec. 5, 1961	6.0*
				Dec. 5, 1961	6.8*
				Dec. 5, 1961	6.2*
Celery	1	Calif.	Santa Cruz	June 20, 1960	3.3
			San Diego	Jan. 18, 1961	2.1
			Monterey	June 7, 1961	1.7
				June 29, 1961	7.9
				Aug. 23, 1961	1.4
			San Luis Obispo	Dec. 14, 1961	14*
			Santa Barbara	Dec. 14, 1961	2.7*
			Ventura	Jan. 17, 1962	7.4*
			Orange	Jan. 31, 1962	13*
	1	Idaho	Canyon	Sept. 9, 1961	4.5
	2	Colo.	Adams	July 25, 1961	5.3
	5	Mich.	Allegan	July 27, 1961	5.7
			Kent	July 27, 1961	4.3
			Ottawa	July 27, 1961	2.9
				July 27, 1961	14
			Muskegan	July 28, 1961	8.4
				Aug. 2, 1961	7.7
			LaPeer	Aug. 14, 1961	3.5
			Van Buren	Aug. 14, 1961	3.0
	7	Ohio	Huron	Aug. 17, 1961	3.9
				Aug. 29, 1961	4.4
	10	N. J.	Warren	Sept. 7, 1961	3.7
			Burlington	Oct. 1, 1961	1.0*
			Hunterdon	Oct. 10, 1961	10*
	11	Pa.	Bucks	Oct. 4, 1961	37*
Chard	1	Calif.	Butte	Jan. 22, 1962	61*
Collards	9	N. C.	Cumberland	Dec. 21, 1961	88*
	10	Va.	Norfolk	Dec. 18, 1961	29*
Lettuce	1	Calif.	Monterey	May 23, 1961	3.7
				May 24, 1961	3.5
				June 6, 1961	1.5
				June 13, 1961	1.2
				June 22, 1961	1.0

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Lettuce—continued			Santa Cruz	June 8, 1961	1.5
				June 22, 1961	1.0
			Contra Costa	Oct. 9, 1961	2.8*
				Nov. 2, 1961	2.3*
			Imperial	Jan. 11, 1962	6.4*
			Riverside	Jan. 22, 1962	16*
			Sacramento	Jan. 23, 1962	130*
			Santa Clara	Jan. 23, 1962	69*
	1	Wash.	King	Sept. 26, 1961	2.4*
			Pierce	Sept. 28, 1961	3.6*
			Yakima	Nov. 8, 1961	2.4*
	2	Colo.	Alamosa	Aug. 15, 1961	1.7
			Saguache	Aug. 22, 1961	1.7
			Rio Grande	Sept. 13, 1961	4.2
	3	Ariz.	Maricopa	Nov. 15, 1961	9.3*
			Yuma	Dec. 4, 1961	7.9*
				Jan. 8, 1962	13*
	3	N. Mex.	Dona Ana	Oct. 12, 1961	0.7*
				Oct. 14, 1961	0.9*
	3	Tex.	Hidalgo	Mar. 8, 1961	0.5
			Zavala	Nov. 11, 1961	4.1*
				Apr. 25, 1961	1.1
				Apr. 25, 1961	1.7
			Deaf Smith	Sept. 26, 1961	5.1*
			Uvalde	Nov. 15, 1960	4.1*
	5	Mich.	Newargo	Aug. 3, 1961	1.5
			Macomb	Aug. 9, 1961	17
			Ingham	Aug. 15, 1961	3.5
				Aug. 15, 1961	4.3
	7	Ohio	Huron	Aug. 17, 1961	3.7
				Aug. 29, 1961	3.8
			Stark	Aug. 25, 1961	3.2
	10	N. J.	Cumberland	Nov. 7, 1961	13*
Onions	1	Calif.	Stanislaus	June 5, 1961	5.0
			San Joaquin	Aug. 5, 1961	1.6
				Aug. 5, 1961	0.6
			Montrose†	Oct. 2, 1961	13*
	1	Idaho	Payette	Nov. 18, 1960	5.5
	1	Oreg.	Washington	Sept. 1, 1961	2.1
			Malheur	Oct. 31, 1961	3.5*
	2	Colo.	Adams	Aug. 21, 1961	5.6
			Weld	Aug. 28, 1961	9.9
			Delta	Oct. 4, 1961	5.9*
			Prowers	Oct. 12, 1961	6.4*
			Otero	Oct. 14, 1961	6.8*
	3	Tex.	Hidalgo	Mar. 16, 1961	1.8
				Mar. 28, 1961	1.2
				Mar. 30, 1961	1.3
			Zavala	Apr. 25, 1961	1.4
	4	Minn.	Clay	Oct. 1, 1961	6.4*
	11	N. Y.	Genesee	Sept. 14, 1960	0.3
	7	Ohio	Huron	Aug. 17, 1961	5.3
				Sept. 10, 1960	2.1
Parsley	1	Calif.	Monterey	Jan. 6, 1962	130*
				Jan. 10, 1962	53*
			San Benito	Jan. 10, 1962	94*
			San Mateo	Jan. 15, 1962	140*
			Fresno	Jan. 22, 1962	180*
				Jan. 22, 1962	79*
			Orange	Feb. 1, 1962	65*
	10	Md.	Baltimore	Nov. 9, 1961	44*
Parsnips	1	Wash.	Spokane	Nov. 15, 1961	3.9*
Peas					
dry	1	Oreg.	Union	Oct. 31, 1961	7.8*
fresh	3	Tex.	Sullivan	Nov. 20, 1961	3.9*
shelled	4	Minn.	Steele	July 12, 1961	6.6
				July 21, 1961	4.6
			Faribault	July 13, 1961	2.1
			Brown	July 25, 1961	3.3
Peppers	3	Tex.	Hidalgo	Dec. 9, 1961	0.4*
				Dec. 18, 1961	0.7*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin: Harvest region	Origin: State or country	Origin: County	Harvest or collection date	Sr^{90} (μμc/kg)
Peppers—continued	10	Md.	Baltimore	Nov. 8, 1961	3.5*
			Montgomery	Nov. 8, 1961	0.0*
	10	N. J.	Cumberland	Nov. 7, 1961	2.4*
Potatoes	1	Idaho	Madison	Oct. 1, 1961	4.5*
			Bonneville	Oct. 10, 1961	2.1*
			Jerome	Oct. 11, 1961	1.2*
			Twin Falls	Oct. 11, 1961	0.8*
			Canyon	Dec. 18, 1961	2.0*
			Payette	Dec. 21, 1961	1.5*
	1	Oreg.	Baker	Sept. 27–Oct. 21, 1961	0.9*
	1	Wash.	Yakima	July 10, 1961	0.7
			Grant	Oct. 10, 1961	1.0*
			Franklin	Nov. 29, 1961	1.2*
	2	Colo.	Weld	Apr. 8–28, 1961	1.6
				Sept. 15–Oct. 3, 1961	1.9*
			Rio Grande	Oct. 1961	1.9*
			Alamosa	Oct. 1, 1961	1.3*
			Morgan	Oct. 1, 1961	0.4*
			Montrose	Nov. 14, 1961	0.8*
			Grand	Nov. 16, 1961	2.5*
	3	Tex.	Crosby	Aug. 3, 1960	0.4
				June 26, 1961	2.7
				July 20, 1961	0.7
			Deaf Smith	June 25, 1961	0.9
			Hale	Nov. 1, 1961	2.0*
			Parmer	Nov. 5, 1961	0.4*
			Castro	Nov. 18, 1961	1.4
			Gaines	Nov. 21, 1961	2.1*
	4	Minn.	Anoka	Sept. 15, 1961	1.0*
			Sherburne	1961	3.1
	5	Mich.	Bay	Sept. 1, 1961	1.1
	5	Wis.	Barron	Oct. 1, 1961	3.5*
			Walworth	Nov. 1, 1961	0.8*
	6	Ill.	Granite†	July 11, 1960	11
	10	N. J.	Monmouth	Oct. 7–14, 1961	2.0*
			Cumberland	Nov. 8, 1961	3.3*
			Middlesex	Nov. 16, 1961	1.6*
	11	N. Y.	Suffolk	Sept. 10, 1961	1.4
				Sept. 10, 1961	1.3
				Sept. 10, 1961	1.7
				Sept. 10, 1961	1.2
				Sept. 10, 1961	1.8
				Sept. 10, 1961	1.9
				Sept. 10, 1961	1.6
				Sept. 10, 1961	0.4
Potatoes, sweet					
peels	1	Calif.	Orange	Dec. 1, 1961	4.3*
				Dec. 1, 1961	4.1*
whole	3	Tex.	Camp	Oct. 1, 1961	16*
			Van Zandt	Oct. 1, 1961	20*
			Rains	Oct. 10, 1961	11*
			Wood	Oct. 10, 1961	20*
peels				Oct. 10, 1961	85*
whole	9	N. C.	Union	Oct. 1, 1960	24
			Columbus	Oct. 1, 1961	14*
			Martin	Oct. 1, 1961	24*
whole	10	Va.	Accomac	Oct. 25, 1961	23*
peels				Oct. 25, 1961	51*
whole	10	N. J.	Atlantic	Nov. 21, 1961	14*
Rutabagas	1	Wash.	Yakima	Oct. 15, 1961	2.7*
Soybeans	2	Colo.	Larimer	Sept. 28, 1960	11.0
				Oct. 26, 1961	7.1*
			Prowers	Oct. 26, 1961	11*
	3	Tex.	Hale	Nov. 1–11, 1961	12*
				Nov. 1961	10*
				Dec. 8, 1961	18*
	4	Minn.	Sibley	Oct. 9–14, 1961	17*
	5	Mich.	Monroe	Oct. 23, 1961	35*
	6	Ill.	Madison	Oct. 5, 1960	31
			La Salle	Nov. 1961	13*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin: Harvest region	Origin: State or country	Origin: County	Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
Soybeans—continued	7	Ind.	Fulton	Sept. 15–30, 1961	34.5*
	7	Ohio	Clinton	Oct. 16, 1961	32*
	9	N. C.	Johnston	Dec. 1, 1961	110*
	10	Md.	Wicomico	Nov. 21, 1961	65*
	10	Va.	Accomac	Nov. 1961	11*
Spinach	1	Calif.	San Joaquin	Mar. 14, 1961	2.8
			Orange	Mar. 15, 1961	3.8
			Yolo	Mar. 21, 1961	4.9
				Mar. 28, 1961	7.1
			Monterey	Mar. 28, 1961	6.9
				Apr. 5, 1961	5.0
				Apr. 5, 1961	6.4
			Stanislaus	Apr. 11, 1961	4.6
			Ventura	Apr. 26, 1961	7.4
				May 4, 1961	3.4
				May 11, 1961	2.7
	6	Ark.	Mississippi	Mar. 23, 1961	45
			Van Buren	Apr. 12, 1961	43
	6	Mo.	Crawford	Apr. 12, 1961	37
				May 10, 1961	43
	10	Md.	Baltimore	Nov. 14, 1961	7.0*
			Kent	Nov. 15, 1961	34*
	10	N. J.	Salem	Oct. 10, 1961	22*
			Cumberland	Oct. 17, 1961	21*
				Oct. 24, 1961	29*
				Oct. 31, 1961	28*
				Nov. 8, 1961	31*
	10	Va.	Accomac	Nov. 14, 1961	20*
Squash	1	Wash.	Spokane	Sept. 20, 1961	6.6*
	3	Tex.	Hidalgo	Dec. 7, 1961	2.7*
	4	Minn.	Anoka	Sept. 15, 1961	12*
Tomatoes	1	Calif.	San Benito	Sept. 14, 1960	0.2
			Yolo	Sept. 15, 1960	0.2
			Ventura	Dec. 13, 1961	0.9*
			Sutter	Dec. 18, 1961	1.4*
			San Diego	Feb. 15, 1962	0.2*
	1	Wash.	Yakima	Sept. 13, 1961	0.1
			Walla Walla	Sept. 20, 1961	0.1*
	2	Colo.	Davis†	Aug. 23, 1961	1.1
			Mesa	Aug. 28, 1961	0.8
			Delta	Sept. 12, 1961	0.8
			Morgan	Sept. 22, 1961	2.5*
	2	Utah	Weber	Sept. 13, 1960	0.5
				Aug. 23, 1961	2.9
	3	N. Mex.	Otero	Oct. 16, 1961	0.5*
	3	Tex.	Hidalgo	June 8, 1961	0.2
				June 22, 1961	0.4
				June 26, 1961	0.5
				June 27, 1961	0.4
			Cameron	June 20, 1961	0.1
			Floyd	Oct. 8, 1961	0.5*
	5	Mich.	Lenawee	Aug. 24, 1960	0.3
	7	Ind.	Tipton	Sept. 13, 1960	0.8
			Wells	Sept. 22, 1960	1.3
				Sept. 23, 1960	0.6
	7	Ohio	Williams	Sept. 2, 1960	0.5
	9	Fla.	Hendry	Jan. 10–17, 1961	1.9
	10	Md.	Wicomico	Sept. 25, 1961	1.0*
			Dorchester	Sept. 26, 1961	4.0*
			Baltimore	Sept. 28, 1961	1.5*
	10	Va.	Scott	Sept. 28, 1961	3.3*
	10	W. Va.	Morgan	Sept. 27, 1961	3.7*
				Sept. 27, 1961	5.1*
	11	N. Y.	Niagara	Sept. 19–20, 1960	1.2
			Ontario	Sept. 27, 1961	2.1*
	11	Pa.	Montgomery	Nov. 9, 1961	1.2*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin: Harvest region	Origin: State or country	Origin: County	Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
Tomatoes—continued	12	Mass.	Bristol	Sept. 1960	1.2
			Middlesex	Sept. 7-8, 1960	1.2
Turnips	1	Calif.	San Diego	Feb. 15, 1962	2.8*
	1	Wash.	Multnomah†	Feb. 8, 1961	13
			Spokane	Nov. 7, 1961	10*
			Pierce	Nov. 15, 1961	8.8*
	3	Ariz.	Maricopa	Oct. 31, 1961	5.4*
	4	Minn.	Anoka	Oct. 30, 1961	12*
	11	Pa.	Montgomery	Nov. 9, 1961	6.5*
Fruit					
Apples	1	Calif.	Santa Clara	Sept. 10, 1960	0.3
				Aug. 15, 1961	0.2
				Aug. 15, 1961	0.2
				Aug. 20, 1961	0.3
	1	Idaho	Payette	Nov. 4, 1961	0.3*
			Canyon	Dec. 14, 1961	0.4*
			Washington	Dec. 15, 1961	0.4*
	1	Oreg.	Hood River	Oct. 15, 1961	0.5*
	1	Wash.	Yakima	Sept. 25, 1961	0.2*
			Klickitat	Oct. 15, 1961	0.6*
			Columbia	Nov. 30, 1961	0.4*
	2	Colo.	Fremont	Sept. 10, 1961	0.3
			Mesa	Nov. 16, 1961	0.4*
	2	Utah	Utah	Aug. 29, 1961	1.0
	3	N. Mex.	Lincoln	Aug. 9, 1961	0.6
	4	Minn.	Houston	Sept. 1, 1961	1.4
				Sept. 1, 1961	1.4
	5	Mich.	Macomb	Aug. 11, 1961	1.3
	5	Wis.	Jefferson	Oct. 1, 1961	1.2*
	6	Ill.	Calhoun	Oct. 1, 1961	1.7*
	10	Md.	Wicomico	Oct. 3, 1961	0.4*
			Somerset	Oct. 4, 1961	0.9*
			Washington	Oct. 10, 1961	0.0*
	10	N. J.	Burlington	Oct. 1, 1961	1.8*
			Warren	Oct. 9, 1961	1.3*
			Gloucester	Nov. 1, 1961	1.8*
	10	W. Va.	Hampshire	Oct. 7, 1960	2.6
				Oct. 9, 1961	2.0*
			Jefferson	Oct. 16, 1961	0.6*
	11	N. Y.	Orange	Oct. 5, 1961	1.9*
				Oct. 7, 1961	1.5*
			Columbia	Oct. 9, 1961	1.3*
	11	Pa.	Bucks	Oct. 4, 1961	0.8*
			Lehigh	Oct. 5, 1961	1.0*
			Berks	Oct. 29, 1961	1.8*
Cranberries	1	Oreg.	Coos	Nov. 22, 1961	12*
			Curry	Nov. 22, 1961	17*
	1	Wash.	Grays Harbor	Oct. 13, 1961	13*
			Pacific	Nov. 30, 1961	14*
Peaches	1	Calif.	Kern	June 7, 1961	0.4
			Stanislaus	Aug. 7, 1961	0.4
			San Joaquin	Aug. 22, 1961	0.4
			Merced	Sept. 14, 1961	0.5
	2	Colo.	Mesa	Aug. 20, 1961	1.4
				Aug. 26, 1961	1.2
	2	Utah	Weber	Sept. 9, 1960	1.2
			Box Elder	Sept. 21, 1961	2.2*
	5	Mich.	Mason	Aug. 30, 1960	1.4
			Wayne	Sept. 8, 1960	1.2
			Oceana	Sept. 12, 1960	1.6
			Van Buren	Sept. 21, 1960	1.2
	10	Md.	Washington	Sept. 6, 1961	1.4
	10	Va.	Rappahannock	Aug. 20, 1960	1.6
			Accomac	Sept. 1, 1961	2.1
			Frederick	Sept. 1, 1961	2.4

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin: Harvest region	Origin: State or country	Origin: County	Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
Peaches—continued	11	N. Y.	Niagara	Sept. 1, 1960	1.1
Raisins, Muscat	1	Calif.	Fresno	Sept. 8, 1960	1.3
Strawberries	1	Calif.	Santa Cruz	Nov. 1, 1960	1.1
				May 10, 1961	1.1
				Sept. 28, 1961	0.9*
			Orange	Apr. 27, 1961	1.5
				Apr. 28, 1961	1.8
			Ventura	Apr. 27, 1961	1.1
			Fresno	May 3, 1961	2.8
			San Luis Obispo	May 3, 1961	0.9
	1	Wash.	Pierce	June 27, 1961	6.9
			Scagit	June 30, 1961	3.3
	4	Kans.	Miami	June 7, 1961	11
	5	Mich.	Berrien	July 13, 1961	18
			Houghton	July 17, 1961	29
				July 20, 1961	18
				July 20, 1961	27
	5	Wis.	Door	July 10, 1961	11
				July 10, 1961	2.5
	6	Ark.	Johnson	May 15, 1961	35
	7	Ind.	Knox	June 13, 1961	19
	8	La.	Livingston	Mar. 20, 1961	12
			Tangipahoa	Apr. 12, 1961	21
	8	Tenn.	Madison	May 10, 1961	22
			Rhea	June 7, 1961	34
			Sumner	June 8, 1961	24
	9	Fla.	Dade	Jan. 12, 1961	4.1
			Palm Beach	Jan. 18, 1961	14
			Manatee	Apr. 4, 1961	5.2
			Hillsborough	Apr. 3, 1961	3.6
	9	N. C.	Duplin	Apr. 1, 1961	18
	10	Del.	Sussex	May 22, 1961	17
	10	N. J.	Cumberland	June 5, 1961	10
				June 5, 1961	12
	10	Va.	Princess Anne	May 18, 1961	24
			Accomac	May 19, 1961	16
	11	N. Y.	Erie	June 16, 1961	14
			Orleans	June 26, 1961	11
	12	Mass.	Barnstable	June 15, 1961	21
			Middlesex	June 27, 1961	13
Dairy products					
Cheese, cheddar	1	Idaho		Oct. 1, 1961	130*
				Nov. 1, 1961	120*
	1	Oreg.		Mar. 9, 1961	62
				Oct. 1, 1961	67*
	2	Utah		Aug. 28, 1960	23
	4	Minn.		Aug. 31, 1960	51
				Dec. 30, 1961	21*
	6	Ill.		Feb. 11, 1960	44
				Nov. 8, 1960	35
				Jan. 21, 1961	54
				Feb. 21, 1961	42
	6	Mo.		Sept. 1, 1960	38
				Oct. 20, 1960	48
				Nov. 1, 1960	38
				Feb. 27, 1961	80
	11	N. Y.		Sept. 13, 1960	43
				Oct. 26, 1960	12
				Nov. 29, 1960	19
				Jan. 31, 1961	48
				Feb. 23, 1961	53
	7	Ohio		Oct. 3, 1960	32
				Oct. 31, 1960	62
				Nov. 30, 1960	54
				Jan. 4, 1961	42
				Feb. 28, 1961	57
Eggs					
substance	1	Calif.	Sonoma	Feb. 1, 1961	3.0

See p. 284 for footnotes

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} (μμc/kg)
	Harvest region	State or country	County		
Eggs—continued					
shell					200
substance				June 13, 1961	3.5
shell					490
substance			Stanislaus	1960	2.3
substance	4	Minn.	Wright	Dec. 12, 1960	1.6
shell					130
shell				Dec. 19, 1961	390*
substance	5	Mich.	Kalamazoo	Oct. 24, 1960	0.7
substance				Jan. 26, 1961	2.0
substance				Mar. 15, 1961	3.8
shell					1200
substance	6	Mo.	Franklin	Mar. 29, 1961	2.4
shell					550
substance	10	N. J.	Cumberland	Oct. 6, 1961	3.2*
substance	11	Pa.	Bucks	Oct. 6, 1961	1.3*
Milk					
Evaporated	1	Calif.		Nov. 7, 1960	2.4
				Dec. 12, 1960	4.2
				Dec. 15, 1960	3.3
		Wash.		Dec. 9, 1961	21
	4	Minn.		Feb. 1, 1960	13
	5	Wis.		Dec. 1, 1960	8.6
				Dec. 14, 1960	12
				Feb. 20, 1961	8.9
	6	Ark.		Dec. 5, 1960	64
	6	Ill.		Dec. 2, 1960	18
				Dec. 12, 1960	12
	7	Ky.		Dec. 6, 1960	22
	7	Ohio		Nov. 1, 1960	16
	8	Tenn.		Dec. 1, 1960	32
	9	N. C.		Dec. 6, 1960	24
	11	Pa.		Sept. 15, 1960	24
Grain					
Corn					
grain	2	Colo.	Weld	Nov. 1, 1961	0.2*
			Morgan	Oct. 20, 1961	0.3*
meal	3	N. Mex.	Sandoval	Sept. 20, 1960	1.7
				Sept. 20, 1960	1.5
grain			Curry	Sept. 1, 1961	0.8
meal				Sept. 1, 1961	0.3
grain	3	Tex.	Fannin	Nov. 8, 1961	0.2*
grain	4	Minn.	Carver	Oct. 20, 1960	2.0
meal				Oct. 20, 1960	3.5
grain	4	S. D.		1961	2.4
grain	5	Wis.	Milwaukee	1960	2.5
meal				1960	2.0
grain			Fond du Lac	Oct. 16, 1961	0.5*
grain	7	Ind.	Cass	June 15, 1960	8.8
grain	9	Ga.	Grady	Aug. 1, 1960	2.0
meal				Aug. 1, 1960	1.8
grain			Laurens	Nov. 9, 1960	2.4
meal				Nov. 9, 1960	1.9
grain	9	N. C.	Hertford & Northampton	Jan. 19, 1962	0.3*
meal				Jan. 19, 1962	0.0*
grain	10	Md.	Carroll	Sept. 1, 1961	0.0
meal				Sept. 1, 1961	1.0
grain	11	Va.	Louisa	Sept. 1, 1961	0.0
meal					
Rice					
rough	1	Calif.	Butte	Oct. 8–11, 1960	0.2
milled				Oct. 8–11, 1960	2.8
rough			Fresno	Oct. 15, 1960	1.1
milled				Oct. 15, 1960	0.1
rough			Merced	Oct. 10, 1960	1.9
milled				Oct. 10, 1960	0.3

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
	Harvest region	State or country	County		
Rice—continued					
rough	3	Tex.	Brazoria	Oct. 1-16, 1961	6.5*
milled				Oct. 1-16, 1961	1.0*
rough			Jackson	Oct. 1, 1961	7.4*
milled				Oct. 1, 1961	1.5*
rough			Jefferson	Oct. 1, 1961	8.3*
milled				Oct. 1, 1961	0.5*
rough			Harris	Oct. 1, 1961	6.9*
milled				Oct. 1, 1961	1.7*
rough	6	Ark.	Jackson	Oct. 1, 1960	1.3
Rye	2	Colo.	Bent	July 1, 1960	14
	2	Wyo.	Platte	Aug. 1961	9.4
	5	Mich.	Bay	Aug. 1961	23
	7	Ohio	Wood	July 5, 1961	15
Flour	10	Va.	Louisa	July 1, 1961	25
Wheat	1	Idaho	Elmore	Aug. 9, 1960	5.7
			Bonneville	July 5, 1961	5.1
				Sept. 5, 1961	5.4
	2	Colo.	Rogan†	July 1, 1961	41
			Adams	July 10, 1961	16
			Phillips	July 18, 1961	16
			Pueblo	Aug. 1, 1961	18
	2	Mont.	Gallatin	Mar. 29, 1961	7.2
			Toole	Dec. 20, 1961	2.5*
				Dec. 20, 1961	1.9*
	6	Utah	Cache	July 15–Aug. 15, 1960	3.4
	3	N. Mex.	Curry	June 1, 1961	6
	3	Tex.	Denton	May 1, 1961	16
			Callahan	June 15, 1961	6.4
	4	Minn.	Olmstead	July 1, 1960	55
	5	Mich.	Monroe	July 28, 1960	19
				Aug. 1, 1961	18
	6	Mo.	Texas	July 1, 1960	50
	7	Ohio	Mahoning	Aug. 1, 1961	22
			Paulding	Aug. 1, 1961	11
	9	Ga.	Bartow	June 15, 1961	3
	9	N. C.	Tredell†	July 1, 1960	45
	9	S. C.	York	June 15–July 1, 1960	29
			Anderson	June 15–July 15, 1960	27
	10	Md.	Frederick	July 1960	29
			Carroll	Oct. 1960	26
			Washington	Jan. 3, 1962	18*
	10	W. Va.	Greenbrier	Oct. 1960	58
	10	Va.	Hanover	Feb. 5, 1962	5.9*
	11	N. Y.	Onondaga	1960	24
			Genesee	Aug. 1960	11
Beverage Bases					
Cocoa beans		Africa			
		(Angola)		Feb. 24, 1961	14
		(Cameroums)		Jan. 22, 1962	20*
		(Ivory Coast)		Dec. 18, 1961	25*
		Dominican Republic		Dec. 8, 1961	18*
Coffee beans		Africa			
		(Ivory Coast)		Feb. 14, 1961	43
		(BEA)		Feb. 14, 1961	15
		Mexico		Jan. 4, 1961	22
				Dec. 18, 1961	25*
				Dec. 20, 1961	25*

See p. 284 for footnotes.

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin: Harvest region	Origin: State or country	Origin: County	Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
Tea		Argentina		Nov. 3, 1960	37
				May 24, 1961	47
		Belgian Congo		Feb. 26, 1962	15**
		British East Africa		Feb. 26, 1962	43**
				Mar. 24, 1962	56
		Brazil		Dec. 14, 1960	160
				May 24, 1961	200
		Ceylon		Nov. 1, 1960	315
				Jan. 12, 1961	258
				Jan. 12, 1961	267
				Jan. 12, 1961	376
				Jan. 30, 1961	110
				Nov. 29, 1961	142**
				Nov. 29, 1961	244**
				Dec. 1, 1961	204**
				Dec. 11, 1961	183**
				Dec. 11, 1961	97**
				Dec. 15, 1961	219**
				Jan. 11, 1962	279**
				Jan. 18, 1962	253**
				Jan. 18, 1962	167**
				Jan. 23, 1962	175**
				Jan. 24, 1962	154**
				Jan. 26, 1962	169**
				Feb. 6, 1962	193**
		Formosa		Oct. 11, 1960	450
				June 16, 1961	1120
		India		Mar. 27, 1960	310
				Oct. 11, 1960	115
				Oct. 27, 1960	240
				Jan. 30, 1961	780
				Mar. 30, 1961	1163
				Jan. 25, 1962	89
				Feb. 5, 1962	193**
				Feb. 5, 1962	1629**
				Feb. 5, 1962	1092**
				Feb. 6, 1962	1133**
				Feb. 14, 1962	275**
				Feb. 14, 1962	293**
		Indonesia		Feb. 8, 1962	68**
				Feb. 8, 1962	29**
		Japan		Oct. 18, 1960	180
				Jan. 30, 1961	490
		Java		Nov. 1, 1960	36
				Jan. 30, 1961	71
				June 16, 1961	83
		Kenya		Oct. 17, 1960	19
				Mar. 30, 1961	49
		Mozambique		May 24, 1961	15
		Pakistan		Jan. 9, 1962	662**
		Sumatra		Nov. 1, 1960	40
				Feb. 13, 1961	57
Fish					
Albacore		Spain		Dec. 7, 1961	0.3*
Bonita		Lima, Peru		Dec. 4, 1961	0.2*
				Dec. 4, 1961	0.4*
				Dec. 8, 1961	0.1*
				Dec. 8, 1961	0.0*
				Dec. 11, 1961	1.0*
Haddock, fillet (skin on)	12	Mass.		Oct. 7, 1961	0.1*
				Aug. 23, 1961	0.2
		Georges Bank		Oct. 26, 1961	0.2*
				Nov. 15, 1961	0.2*
Sardines	12	Maine		Nov. 16, 1960	0.3*
				Nov. 7, 1961	0.7*
				Nov. 8, 1961	1.3*
Tuna		Angola		Dec. 12, 1961	0.0*
		Japan		Oct. 20, 1960	0.1
				Nov. 20, 1961	0.4*
				Dec. 11, 1961	0.3*
				Dec. 11, 1961	0.1*
				Dec. 23, 1961	0.1*

See p. 284 for footnotes.

Table 2.—STRONTIUM-90 CONTENT OF VARIOUS RAW FOODS—Continued

Raw food	Origin			Harvest or collection date	Sr^{90} ($\mu\mu c$/kg)
	Harvest region	State or country	County		
Tuna—continued		Portugal		Dec. 15, 1961	1.7*
Nuts					
Almonds	1	Calif.		Dec. 14, 1960	0.7
Cashew		Africa (Mozambique)		Jan. 26, 1962	0.0*
Peanuts	3	N. Mex.		Nov. 17, 1961 Nov. 17, 1961 Nov. 17, 1961 Jan. 3, 1962 Jan. 3, 1962	14* 16* 11* 14* 15*
	3	Tex.		Dec. 8, 1961	87*
	10	Va.		Feb. 13, 1962	6.8*
Pecans	3	N. Mex.		Nov. 1, 1961	19*
	3	Okla.		Nov. 14, 1961 Nov. 14, 1961	7.4* 3.3*
	3	Tex.		Dec. 14, 1961	4.3*
	9	Ga.		Nov. 15, 1960 Dec. 9, 1960	13 11

* Products harvested after September 15, 1961.
† City
** The date of collection of import is approximately 3 to 4 months after harvest date.

8. South Central .... Alabama, Louisiana, Mississippi, Tennessee
9. South Eastern .... Florida, Georgia, North Carolina, South Carolina
10. Mid Atlantic .... Delaware, Maryland, New Jersey, Virginia, West Virginia
11. Mid Eastern .... New York, Pennsylvania
12. New England .... Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

Figure 1 illustrates the harvest zones listed in table 1, and harvest regions indicated in table 2. The number of samples collected, the average values, and the standard deviations for the regional distribution of strontium–90 in various foods are presented in table 1. Pretesting and post-testing values for each harvest zone are indicated.

Comments

From the data in table 1, several limited observations can be made, since the numbers of samples are small. The 1960–1961 east-west relationship may be noticed in some food items. Pre-test average strontium–90 concentrations in snap beans, carrots, strawberries, and wheat from the east zone are higher than those from the west zone. Post-test average strontium–90 concentrations in cabbage and soybeans from the east zone are higher than in the same items from the west zone. Post-test average strontium–90 concentrations are higher than pretest average strontium–90 concentrations for lettuce and celery in the west zone. In consideration of the contribution of any of the above foods to the strontium–90 content of the total diet, and assuming an "action point" for strontium–90 of 200 $\mu\mu c$/day, none of the values reported so far would form the basis for corrective action.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1958 and 1959	May 1960
1958, 1959, and 1960	January 1961
1960	August 1961
1959 and 1960	September 1961
1958, 1959, 1960, and 1961	December 1961
1960 and 1961	April 1962

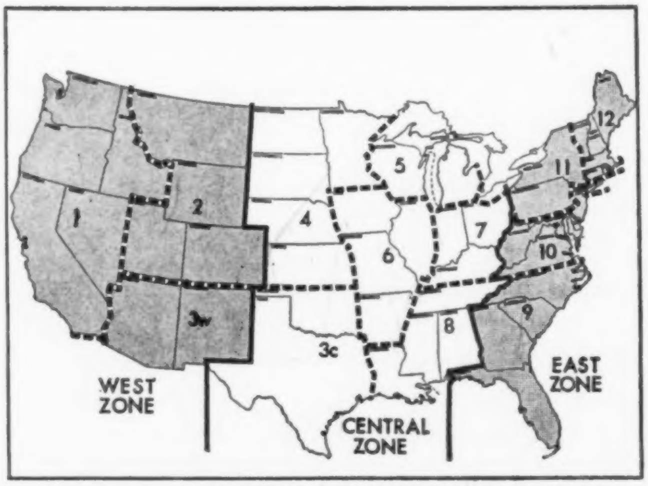

Figure 1.—HARVEST REGIONS AND ZONES

SECTION III.—MILK

Radionuclide Analyses of Pasteurized Milk

PASTEURIZED MILK MONITORING NETWORK
March 1962

Division of Radiological Health, and
Division of Environmental Engineering & Food Protection,
Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical procedures. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were reported concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

The June 1961 raw milk sampling results, reported in the November 1961 *Radiological Health Data (RHD)*, represent the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *RHD* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

During March 1962 the surveillance of pasteurized milk was conducted at 61 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis.[1] The former analyzes samples from the 30 States generally east of the Mississippi River, and the latter analyzes samples from the western States. Publication in *RHD* follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the concentrations of radioactivity in samples of pasteurized milk consumed by the public in various regions of the country,

[1] Northeastern Radiological Health Laboratory began processing of milk samples with those collected after May 7, 1962, for the states of Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, and Connecticut; after May 21, from New York, New Jersey, Pennsylvania, and Delaware; and after June 11 from Illinois, Indiana, Wisconsin, Michigan, and Ohio.

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS, MARCH 1962

and (2) provision of at least one sampling point within virtually all states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

During March 1962, sampling on a weekly basis was performed at most stations. All surveillance data are subject to continuing review and evaluation to observe unusual patterns or concentrations which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing may require an immediate re-evaluation and readjustment of the sampling frequency and analytical schedule for this program.

Iodine–131, cesium–137, and barium–140 are determined by gamma scintillation spectroscopy, while strontium–89 and strontium–90 are determined following radiochemical separation. The minimum detectable concentrations in units of $\mu\mu c$/liter are: Sr^{89}, 5; Sr^{90}, 1; I^{131}, 10; Cs^{137}, 5; and Ba^{140}, 10.

In the previous three issues, *RHD* published graphical presentations of the average monthly concentrations of strontium–90 in pasteurized milk from 20 selected cities from the monitoring network. An additional 16 cities are similarly represented in figure 2.

Figures 3 and 4 portray the strontium–90 and strontium–89 concentrations during March 1962 by means of iso-concentration contours. Still evident, as during December, January, and February, is the strontium–89 pattern of nondetectable concentrations at most stations in the Northeast and North Central sections of the United States, low concentrations in the West, and higher concentrations in the South. The strontium–90 concentrations also generally follow this pattern. This pattern is apparently due to the practice in the North of feeding cat-

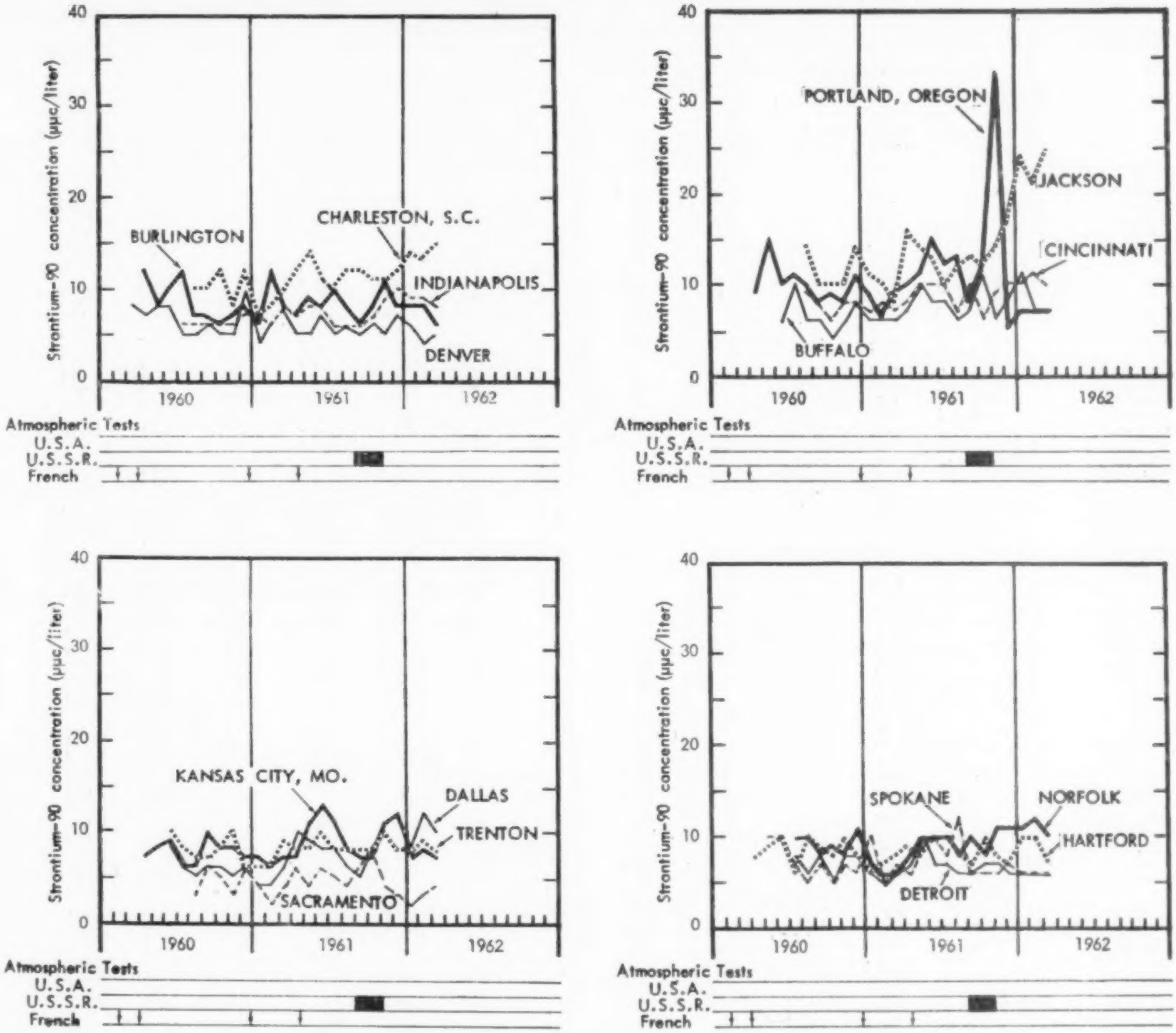

FIGURE 2.—STRONTIUM-90 CONCENTRATIONS IN PASTEURIZED MILK

FIGURE 3.—STRONTIUM-90 ISOCONCENTRATION CONTOURS FOR PASTEURIZED MILK, MARCH 1962

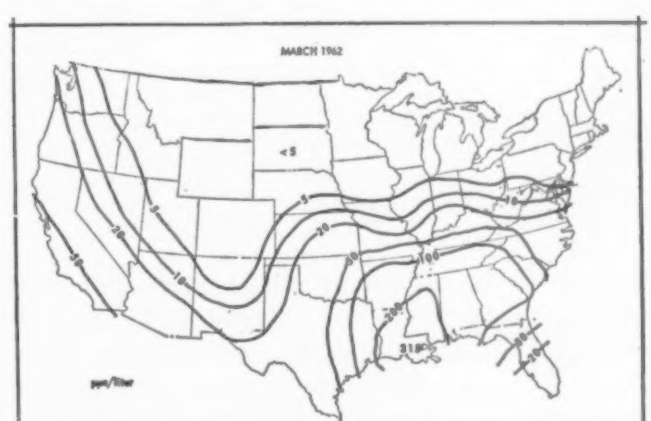

FIGURE 4.—STRONTIUM-89 ISOCONCENTRATION CONTOURS FOR PASTEURIZED MILK, MARCH 1962

TABLE 1.—RADIOACTIVITY IN PASTURIZED MILK, MARCH 1962

[Average radioactivity concentrations in $\mu\mu c$/liter]

Area		Calcium (gm/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	First quarter	Av. for month	First quarter	Av. for month	First quarter	Av. for month	First quarter	Av. for month	First quarter	Av. for month	First quarter	Av. for month
Montgomery	Ala.	1.14	1.21	40	110	12	14	<10	<10	20	20	20	20
Palmer	Alaska	1.05	1.07	5	<5	6	6	<10	10	10	10	<10	10
Phoenix	Ariz.	1.05	1.07	25	25	3	3	<10	10	5	10	<10	10
Little Rock	Ark.	1.18	1.17	105	160	22	23	<10	<10	25	50	20	20
Sacramento	Calif.	1.07	1.08	15	35	3	4	<10	<10	5	10	<10	<10
San Francisco	Calif.	1.10	1.14	40	90	5	8	10	10	10	20	<10	10
Denver	Colo.	1.07	1.10	10	<5	5	5	<10	<10	10	10	<10	<10
Hartford	Conn.	1.14	1.15	<5	<5	9	7	<10	<10	5	<5	<10	<10
Wilmington	Del.	1.17	1.18	5	10	10	9	<10	<10	5	10	<10	<10
Washington	D. C.	1.16	1.17	<5	<5	8	7	<10	<10	<5	<5	<10	<10
Tampa	Fla.	1.22	1.19	20	20	7	6	<10	<10	55	70	<10	<10
Atlanta	Ga.	1.19	1.21	120	130	13	14	<10	<10	30	60	20	20
Honolulu	Hawaii	1.04	1.03	50	30	5	4	10	20	10	20	<10	10
Idaho Falls	Idaho	1.09	1.06	<5	<5	4	4	10	10	5	5	<10	<10
Chicago	Ill.	1.13	1.13	<5	<5	6	5	<10	<10	<5	<5	<10	<10
Indianapolis	Ind.	1.20	1.20	10	20	9	8	<10	<10	5	<5	<10	<10
Des Moines	Iowa	1.07	1.09	5	<5	5	5	<10	10	10	10	<10	10
Wichita	Kans.	1.07	1.10	20	30	7	7	<10	<10	5	10	<10	10
Louisville	Ky.	1.17	1.17	20	35	11	9	<10	<10	10	15	<10	<10
New Orleans	La.	1.22	1.23	325	315	28	28	<10	<10	70	100	50	40
Portland	Maine	1.20	1.22	<5	<5	11	10	<10	<10	15	20	<10	<10
Baltimore	Md.	1.17	1.18	<5	<5	9	8	<10	<10	5	<5	<10	<10
Boston	Mass.	1.19	1.19	<5	<5	10	10	<10	<10	15	20	<10	<10
Detroit	Mich.	1.16	1.18	<5	<5	6	6	<10	<10	<5	<5	<10	<10
Grand Rapids	Mich.	1.19	1.20	<5	<5	8	8	<10	<10	10	20	<10	<10
Minneapolis	Minn.	1.07	1.11	5	<5	6	6	10	20	10	10	<10	10
Jackson	Miss.	1.27	1.26	245	220	23	25	<10	<10	40	70	40	40
Kansas City	Mo.	1.05	1.09	15	20	7	7	10	10	10	10	<10	10
St. Louis	Mo.	1.07	1.12	10	10	8	8	<10	10	10	10	10	20
Helena	Mont.	1.08	1.10	5	5	4	4	20	20	<5	<5	<10	<10
Omaha	Nebr.	1.09	1.16	10	5	5	5	<10	10	5	10	<10	10
Manchester	N. H.	1.17	1.16	<5	<5	10	10	<10	<10	25	30	<10	<10
Trenton	N. J.	1.16	1.17	<5	<5	8	8	<10	<10	5	15	<10	<10
Albuquerque	N. Mex.	1.07	1.11	10	<5	4	3	20	20	<5	<5	10	10
Buffalo	N. Y.	1.13	1.16	<5	<5	8	7	<10	<10	5	10	<10	<10
New York	N. Y.	1.13	1.12	<5	<5	9	8	<10	<10	<5	<5	<10	<10
Syracuse	N. Y.	1.14	1.14	<5	5	7	6	<10	<10	5	10	<10	<10
Charlotte	N. C.	1.20	1.20	25	35	12	13	<10	<10	<5	<5	<10	<10
Minot	N. D.	1.04	1.06	<5	<5	8	8	<10	10	10	10	<10	10
Cincinnati	Ohio	1.18	1.18	15	25	10	10	<10	<10	<5	<5	<10	<10
Cleveland	Ohio	1.16	1.15	<5	<5	8	8	<10	<10	5	10	<10	<10
Oklahoma City	Okla.	1.17	1.16	40	40	9	8	<10	<10	<5	<5	<10	<10
Portland	Oreg.	1.08	1.14	25	20	7	7	<10	<10	15	20	<10	10
Philadelphia	Pa.	1.16	1.17	<5	<5	9	10	<10	<10	<5	<5	<10	<10
Pittsburgh	Pa.	1.17	1.15	<5	5	11	8	<10	<10	<5	<5	<10	<10
San Juan	P. R.	1.14	1.16	110	90	8	9	<10	<10	25	40	20	<10
Providence	R. I.	1.16	1.16	<5	<5	9	9	<10	<10	10	20	<10	<10
Charleston	S. C.	1.22	1.23	80	95	14	15	<10	<10	25	40	10	10
Rapid City	S. D.	1.09	1.05	10	<5	6	6	10	20	15	15	10	30
Chattanooga	Tenn.	1.24	1.25	110	190	15	20	<10	<10	30	50	20	20
Memphis	Tenn.	1.21	1.20	120	125	15	16	<10	<10	<5	<5	20	20
Austin	Tex.	1.16	1.17	25	30	5	7	<10	<10	<5	<5	<10	<10
Dallas	Tex.	1.21	1.18	55	80	10	10	<10	<10	5	10	<10	<10
Salt Lake City	Utah	1.08	1.08	<5	<5	4	3	10	10	5	5	<10	<10
Burlington	Vt.	1.16	1.15	<5	<5	7	6	<10	<10	10	<5	<10	<10
Norfolk	Va.	1.22	1.25	20	40	11	10	<10	<10	5	10	<10	<10
Seattle	Wash.	1.07	1.10	15	10	6	6	<10	10	15	15	<10	10
Spokane	Wash.	1.07	1.10	<5	<5	6	6	10	20	10	10	<10	10
Charleston	W. Va.	1.15	1.16	10	10	9	8	<10	<10	<5	<5	<10	<10
Milwaukee	Wis.	1.20	1.20	<5	<5	6	5	<10	<10	5	<5	<10	<10
Laramie	Wyo.	1.05	1.07	<5	<5	4	4	10	10	10	10	<10	10
Network average		1.14	1.15	30	35	8.7	8.6	<10	<10	11	16	<10	<10

tle during the winter on silage harvested prior to the resumption of atmospheric nuclear weapons testing and dairy cattle in the South feeding on pasture contaminated by relatively fresh fission products. Strontium–90 concentrations have shown no marked upward change during March 1962 except for minor fluctuations which occur normally from month to month. Iodine–131 concentrations in milk continue to be less than the minimum level of detection at most stations during March.

Table 1 presents a summary of all available analyses for March 1962. These data are an average of weekly samples in most instances.

When a radionuclide is reported by the laboratory as being below the minimum detectable concentration, one-half of this value is used for calculating the monthly average. A similar procedure is used for the network average.

Editor's note: Preliminary data for May 1962 indicate that increased amounts of iodine–131 have appeared in pasteurized milk samples from a number of states located mostly in mid-continental sections of the U. S. The normal weekly sampling schedule has been increased to a semi-weekly sampling interval.

STRONTIUM–90 IN MINNESOTA MILK
May 1961–February 1962

Division of Environmental Sanitation
Minnesota Department of Health

The Minnesota State Department of Health, Division of Environmental Sanitation, initiated a small bovine milk surveillance network in September 1958. Two-ounce samples, collected daily at each of the network stations (see figure 1) are composited and analyzed monthly for strontium–90. Collection is made at the bottling machines so that the sample is randomly representative of the milk produced in that milkshed. The most recently reported data from this network are presented in table 2.

FIGURE 5.—MINNESOTA MILK SAMPLING LOCATIONS

In October 1961, following the resumption of atmospheric nuclear weapons testing by the U.S.S.R., a special network of sampling stations (see figure 5) was established for the collection of "grab" milk samples at milk processing plants for analysis of iodine–131 concentrations. Data for October–December 1961 were published in the March 1962 *RHD*. During January and February 1962, iodine–131 concentrations were not detectable.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
September 1958–August 1959	April 1960
September 1958–December 1959	July 1960
January–April 1960	December 1960
May–November 1960	June 1961
December 1960–April 1961	October 1961
October–December 1961 (iodine–131 data)	March 1962

TABLE 2.—STRONTIUM-90 IN MINNESOTA MILK, MAY 1961–FEBRUARY 1962

[Concentrations in $\mu\mu c$/liter]

Month	Brainerd	Duluth	Fairmont	Minneapolis	Rochester	Thief River Falls	Worthington
1960 Average	16	13	—	7	6	9	7
May 1961	17	16	—	7	8	8	8
June 1961	13	14	—	8	6	6	—
July 1961	16	12	—	12	8	7	—
August 1961	16	14	—	10	21	10	—
September 1961	17	10	—	6	4	6	—
October 1961	—	14	—	7	5	8	—
November 1961	4	10	4	8	4	7	—
December 1961	13	15	6	7	6	5	—
1961 Average	*13.1	13.3	*5	7.9	7.2	*7.0	*6.4
January 1962	—	10	4	6	6	6	—
February 1962	11	—	4	6	—	5	—

* Average based on less than 12 months' data.

SECTION IV.—WATER

Radioactivity in Raw Surface Waters

NATIONAL WATER QUALITY NETWORK
February 1962

Division of Water Supply & Pollution Control, Public Health Service

The National Water Quality Network, operated in cooperation with State and local agencies and industrial organizations, commenced operations in October 1957. By the end of February 1962, 106 sampling stations were submitting water samples for analyses. These stations are located on major waterways used for public water supply, propogation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and international boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids (strontium–90 on the total solids only) in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere has resulted in an increase in radioactivity of surface waters.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample. Since January 1959, a portion of each sample from all stations in the Network has been composited into a three-

month sample for measurement of strontium-90 concentration.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each made one gross alpha determination per month.

Following the resumption of nuclear weapons testing in the atmosphere, the gross beta and alpha determination schedules were altered. Since September 1, 1961, gross beta determinations have been made on all samples collected (compositing weekly samples for monthly or semimonthly gross beta or alpha determinations will cease). Since October 1, 1961, gross alpha determinations have been made on one sample from each station each month, unless there is evidence of alpha activity in excess of background levels. In the latter instance, an alpha determination has been made on a weekly or bi-weekly basis, depending on what is considered the norm for a particular station.

The data reported in table 1 represent the average of all data reported for the periods indicated. The reported strontium-90 data are the results of determinations on three-month composite samples for the quarter ending in the month shown.

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS, FEBRUARY 1962

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TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Average concentrations in $\mu\mu c$/liter]

Station	Quarter ending Dec. 31, 1961	February 1962					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa	0.3	3	16	19	0	0	0
Animas River: Cedar Hill, N. Mex	0.3	11	32	43	2	4	6
Apalachicola River: Chattahoochie, Fla	0.4	28	24	52	1	0	1
Arkansas River:							
Coolidge, Kans	—	18	149	167	0	45	45
Ponca City, Okla	—	87	58	145	0	2	2
Pendleton Ferry, Ark	—	107	37	144	—	—	—
Big Horn River: Hardin, Mont	—	64	46	110	5	4	9
Big Sioux River: Sioux Falls, S. Dak	0.4	56	174	230	0	3	3
Chattahoochie River:							
Atlanta, Ga	—	10	12	22	1	0	1
Columbus, Ga	—	34	16	50	1	1	2
Clear Water River: East Lewiston, Idaho	—	22	20	42	1	1	2
Colorado River:							
Loma, Colo	—	58	44	102	2	9	11
Page, Ariz	—	68	54	122	21	8	29
Boulder City, Nev	1.0	5	25	30	<1	8	8
Parker Dam, Calif	—	26	39	65	0	9	9
Columbia River:							
Wenatchee, Wash	—	4	8	12	0	1	1
Pasco, Wash	1.1	61	483	544	—	—	—
Bonneville Dam, Oreg	*0.6	30	265	295	0	0	0
Clatskanie, Oreg	—	27	137	164	0	0	0
McNary Dam, Oreg	1.2	79	350	429	0	1	1
Connecticut River:							
Northfield, Mass	0.4	15	16	31	0	0	0
Wilder, Vt	—	6	12	18	0	0	0
Cumberland River: Clarksville, Tenn	0.4	5	17	22	—	—	—
Delaware River:							
Martins Creek, Pa	—	10	18	28	0	0	0
Trenton, N. J	—	21	23	44	0	1	1
Escambia River: Century, Fla	*0.9	37	21	58	1	0	1
Great Lakes:							
Buffalo, N. Y	—	2	8	10	—	—	—
Detroit, Mich	*0.6	7	10	17	0	0	0
Port Huron, Mich	0.4	4	10	14	0	0	0
Milwaukee, Wis	—	5	9	14	1	1	2
Sault Ste. Marie, Mich	—	5	5	10	0	0	0
Gary, Ind	0.2	8	7	15	0	0	0
Duluth, Minn	—	1	3	4	0	0	0
Hudson River: Poughkeepsie, N. Y	0.2	14	38	52	0	0	0
Illinois River:							
Peoria, Ill	0.4	25	43	68	1	0	1
Grafton, Ill	—	60	47	107	4	1	5
Kanawha River: Winfield Dam, W. Va	—	11	14	25	—	—	—
Klamath River: Copco, Oreg	—	12	18	30	—	—	—
Little Miami River: Cincinnati, Ohio	1.1	21	32	53	0	0	0
Merrimack River: Lowell, Mass	*0.7	—	—	—	—	—	—
Mississippi River:							
St. Paul, Minn	0.9	2	11	13	0	2	2
Dubuque, Iowa	—	7	17	24	0	1	1
Burlington, Iowa	0.6	20	19	39	1	1	2
E. St. Louis, Ill	—	24	78	102	2	0	2
Cape Giraudeau, Mo	0.8	54	31	85	1	2	3
West Memphis, Ark	—	55	30	85	4	1	5
Delta, La	*0.4	54	29	83	2	1	3
New Orleans, La	—	72	30	102	8	0	8
Vicksburg, Miss	—	68	35	103	2	<1	2
Missouri River:							
Williston, N. Dak	—	19	25	44	1	2	3
Bismarck, N. Dak	—	4	16	20	0	4	4
Yankton, S. Dak	0.6	24	20	44	4	3	7
Omaha, Nebr	—	19	39	58	1	3	4
St. Joseph, Mo	—	80	28	108	0	0	0
Kansas City, Kans	2.3	94	30	124	—	—	—
St. Louis, Mo	1.4	45	32	77	—	—	—

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

[Average concentrations in $\mu\mu c$/liter]

Station	Quarter ending Dec. 31, 1961	February 1962					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Monongahela River: Pittsburgh, Pa	0.4	9	17	26	0	0	0
North Platte River: Henry, Nebr	—	9	63	72	0	24	24
Ohio River:							
East Liverpool, Ohio	0.4	13	20	33	0	1	1
Huntington, W. Va	—	18	14	32	0	0	0
Cincinnati, Ohio	—	21	11	32	1	0	1
Louisville, Ky	0.4	24	16	40	1	<1	1
Evansville, Ind	—	38	20	58	2	0	2
Cairo, Ill	1.1	59	30	89	2	0	2
Platte River: Plattsmouth, Nebr	—	30	46	76	1	7	8
Potomac River:							
Williamsport, Md	—	40	26	66	0	0	0
Great Falls, Md	—	17	11	28	0	0	0
Rainy River:							
Baudette, Minn	—	15	9	24	1	0	1
International Fls, Minn	—	1	9	10	0	<1	<1
Red River, South:							
Index, Ark	—	33	46	79	—	—	—
Alexandria, La	1.0	70	38	108	6	0	6
Denison, Tex	—	10	61	71	0	1	1
Rio Grande River:							
Alamosa, Colo	*0.4	17	24	41	0	1	1
El Paso, Tex	—	4	20	24	0	3	3
Laredo, Tex	—	7	21	28	0	0	0
Brownsville, Tex	—	9	24	33	2	1	3
Roanoke River: John H. Kerr Resr. & Dam, Va	—	35	20	55	1	<1	1
Sabine River: Ruliff, Tex	—	48	48	96	—	—	—
San Juan River: Shiprock, N. Mex	—	20	26	46	1	14	15
St. Laurence River: Massena, N. Y	—	4	9	13	0	0	0
Schuylkill River: Philadelphia, Pa	—	16	26	42	0	0	0
Savannah River:							
North Augusta, S. C	—	17	10	27	—	—	—
Port Wentworth, Ga	0.4	21	39	60	0	0	0
Shenandoah River: Berryville, Va	—	11	18	29	<1	1	1
Snake River:							
Wawawai, Wash	0.3	12	14	26	0	2	2
Payette, Idaho	—	29	31	60	1	4	5
South Platte River: Julesburg, Colo	0.7	27	38	65	3	38	41
Susquehanna River:							
Sayre, Pa	0.3	6	20	26	0	0	0
Conowingo, Md	0.3	5	18	23	0	0	0
Tennessee River:							
Lenoir City, Tenn	—	28	21	49	<1	0	<1
Chattanooga, Tenn	0.6	28	48	76	1	0	1
Bridgeport, Ala	0.7	—	—	—	—	—	—
Pickwick Landing, Tenn	—	61	45	106	<1	0	<1
Tombigbee River: Columbus, Miss	—	57	30	87	1	0	1
Truckee River: Farad, Calif	—	45	42	87	<1	<1	<1
Wabash River: New Harmony, Ind	—	144	64	208	3	1	4
Yakima River: Richland, Wash	0.4	10	11	21	0	1	1
Yellowstone River: Sidney, Mont	—	25	58	83	1	7	8

* April-September Strontium-90 data.

Radioactivity in Drinking Water

DRINKING WATER ANALYSIS PROGRAM 1961

Division of Environmental Engineering and Food Protection, Public Health Service

The Water Supply Section of the Interstate Carrier Branch, Division of Environmental Engineering and Food Protection, PHS, has gathered extensive data on the radioactivity content of water supplies used on interstate carriers such as trains, airplanes, ships, and other conveyances operating in interstate commerce. This work has several objectives, among which are:

1. to determine radioactivity content of interstate carrier water supplies for comparison with the revised Public Health Service Drinking Water Standards;

2. to establish the radioactivity background level as the base with which to compare future results from the supplies sampled; and
3. to obtain data for study in connection with the occurrence of certain chronic diseases.

Initiated in November 1960, the project is a continuing one under which it is planned to cover ultimately the 850 U. S. water supplies used by interstate carriers. Figure 1 shows the nationwide distribution of the 140 municipalities included in the first sampling. In many instances, there are several sources for a municipality and each is sampled. A second sampling of these cities is underway at the present time. When this is complete, another group of about 100 will be chosen.

Each sample is a composite of 3 aliquots a day obtained during a two week period. The analyses for gross alpha, gross beta, and strontium-90 are performed at the Southeastern and Southwestern Radiological Health Laboratories, operated by the Division of Radiological Health.

Table 1 presents additional data from the first sampling. The data will be published on a regular basis as it becomes available.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1961	May 1962

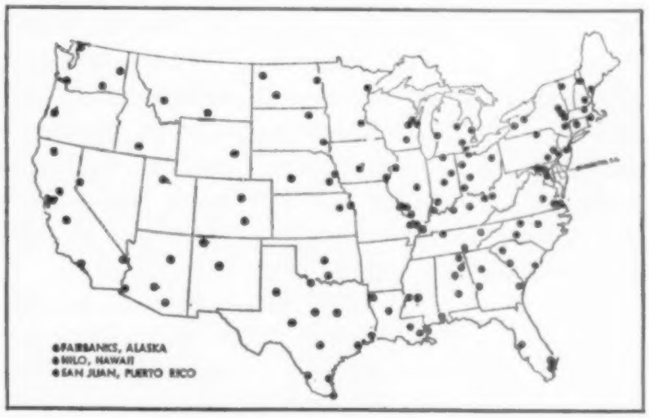

FIGURE 1.—DRINKING WATER ANALYSIS PROGRAM SAMPLING STATIONS

TABLE 1.—RADIOACTIVITY IN DRINKING WATERS (1961)
[Concentrations in $\mu\mu c$/liter]

Station location		Estimated population served	Date sampled	Sr^{90}	Alpha activity			Beta activity		
City	State			Total solids	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Phoenix: Sampling Point 1	Ariz	304,000	7/25–8/8	[a] —	[b] •	•	•	<1.0	<1.0	<2.0
Sampling Point 2			7/25–8/8	—	•	•	•	<1.0	6.6	<7.6
Sampling Point 3			5/15–5/28	—	—	—	—	—	—	—
Sampling Point 4			7/25–8/8	—	•	•	•	<1.0	6.3	<7.3
Sampling Point 5			7/25–8/8	—	•	•	•	<1.0	5.2	<6.2
Sampling Point 6			7/25–8/8	—	•	•	•	<1.0	6.2	<7.2
Fort Lauderdale:	Fla	114,500								
Dixie Plant			4/27–5/11	—	•	•	•	<3.0	5.4	<8.4
Fiveash Plant			4/27–5/12	—	•	•	•	<3.0	<3.0	<6.0
Miami:	Fla	500,000								
Hialeah Plant			3/16–3/31	<1.0	•	•	•	<3.0	<3.0	<6.0
Orr Plant			3/16–3/31	<1.0	•	•	•	<3.0	<3.0	<6.0
Indianapolis:	Ind	530,000								
White River Plant			1/17–2/1	0.3	•	•	—	<2.6	3.2	<5.8
Fall Creek Plant			1/17–2/1	0.3	•	•	—	<2.6	<2.6	<5.2
Shreveport:	La	193,700								
Cross Lake Plant			8/7 –8/25	—	—	—	—	<3.0	4.0	<7.0
McNeill St. Plant			8/7 –8/25	—	—	—	—	<3.0	4.4	<7.4
Baltimore:	Md	1,367,000								
Montebello Plant			10/30–11/13	—	—	—	—	<3.0	4.6	<7.6
Ashburton Plant			10/27–11/10	—	—	—	—	<3.0	6.8	<9.8
Lowell	Mass	97,000	3/16–3/30	—	•	•	•	<3.0	<3.0	<6.0
Monroe	Mich	23,000	4/19–5/3	—	•	•	•	<3.0	4.6	<7.6
Port Huron	Mich	37,800	4/21–5/5	—	•	•	•	<3.0	2.9	<5.9
Greenville	Miss	45,000	1/12–1/27	0.5	—	•	•	<2.6	<2.6	<5.2
North Platte	Neb	15,500	10/24–11/7	—	0.3	11.4	11.7	0.3	14.1	14.4
Bismarck	N. D	23,000	7/18–8/5	—	•	•	•	<1.0	6.6	<7.6
Williston	N. D	10,500	8/29–9/13	—	1.1	14.4	15.5	0.7	12.8	13.5
Toledo	Ohio	425,000	8/17–9/3	—	—	—	—	<3.0	<3.0	<6.0
Ardmore	Okla	26,000	2/8 –2/23	0.7	—	•	•	—	<2.6	—
Aberdeen	S. D	24,000	8/28–9/12	—	9.4	—	9.4	3.8	15.3	19.1
Sioux Falls	S. D	65,000	9/1 –9/15	—	8.9	19.9	28.8	0.1	9.1	9.2
Brownsville:	Tex	50,000								
Plant No. 1			3/30–4/13	—	•	•	•	<3.0	5.0	<8.0
Plant No. 2			3/29–4/12	<1.0	•	•	•	<3.0	3.1	<6.1
Norfolk:	Va	300,000								
Moores Bridge Plant			5/15–5/29	—	•	•	•	<3.0	3.5	<6.5
37th Street Plant			5/16–5/30	—	•	•	•	<3.0	<3.0	<6.0

[a] Dash indicates no determination reported.
[b] • indicates quantity not measurable.

Radioactivity in Minnesota Surface and Ground Waters
August 1959–April 1962

Division of Environmental Sanitation
Minnesota Department of Health

The analysis of various Minnesota waters for radioactivity concentrations was initiated late in 1956 as part of the Minnesota Water Pollution Control Program. This program was expanded in 1958 to include most of the surface municipal water supplies in the State as well as a representative number of ground water supplies and selected lakes throughout the State. Monthly grab samples are usually obtained on raw and treated waters.

Table 1 presents the gross beta data in surface waters for August 1959 through April 1962. The beta activity concentrations in the raw water samples ranged from non-detectable to 234 μμc/liter. Treated water had concentrations ranging from non-detectable to 220 μμc/liter. Figure 1 shows the surface water sampling locations.

The average concentrations of gross alpha activity from selected wells in each Minnesota District are grouped according to their geological formation and presented in table 2. Table 2 shows the ground water sampling districts.

FIGURE 1.—SURFACE WATER SAMPLING LOCATIONS

TABLE 1.—GROSS BETA CONCENTRATIONS IN MINNESOTA SURFACE WATERS
August 1959–April 1962

[Concentrations in μμc/liter]

Town and water source	Sampling date		Raw water	Treated water
Anoka—Mississippi River	1959	October 29	—[a]	9
	1960	May 18	—	14
		September 29	—	4
	1961	April 6	16	[b]ND
		August 29	15	40
Courtland—Minnesota River	1959	November 19	—	25
	1960	April 11	—	22
Crookston—Red Lake River	1959	January 19	30	6
		February 10	100	6
		March 5	2	15
		April 20	81	40
		May 6	80	41
		June 3	36	26
		July 13	26	34
		August 12	94	66
		September 15	18	42
		October 6	23	16
	1960	January 14	22	26
		February 15	24	12
		March 8	6	2
		April 6	17	35
		May 10	5	ND
		June 27	ND	29
Crookston—Con.		July 18	36	29
		August 29	30	4
		September 6	5	21
		October 10	17	ND
		November 10	12	23
		December 2	26	22
	1961	January 9	4	6
		Febuary 7	13	14
		March 13	17	22
		April 11	28	16
		May 22	28	8
		June 5	9	12
		July 5	11	23
		August 7	234	55
		September 8	36	27
		October 5	14	17
		November 13	32	52
		December 8	28	46
		December 27	34	24
	1962	January 31	ND	ND
		March 16	ND	ND
		April 4	48	ND
East Grand Forks—Red Lake River	1961	November 21	37	32

[a] Dash indicates no analysis performed.
[b] ND indicates beta activity not detectable.

TABLE 1.—GROSS BETA CONCENTRATION IN MINNESOTA SURFACE WATERS—Continued
August 1959–April 1962
[Concentrations in μμc/liter]

Town and water source	Sampling date	Raw water	Treated water
East Grand Forks—Con.	November 30	68	33
	December 6	38	37
	December 11	28	9
	December 18	37	18
	December 27	32	5
	1962 January 2	30	10
	January 8	34	27
	January 15	21	23
	January 22	ND	ND
	January 29	ND	ND
	February 5	38	ND
	February 12	28	ND
	February 21	30	25
	March 5	ND	ND
	March 16	28	ND
	March 22	25	ND
	April 4	42	ND
	April 11	89	51
	April 16	58	ND
Elk River—Mississippi River	1959 October 29	17	—
	1960 May 18	ND	—
	September 29	4	—
	1961 February 17	9	—
	April 6	21	—
	August 29	144	—
Eveleth—St. Mary's Lake	1961 November 21	30	15
	November 29	40	33
	December 6	45	59
	December 9	26	25
	December 18	17	17
	December 26	24	18
	1962 January 2	28	12
	January 8	24	37
	January 12	ND	ND
	January 22	ND	ND
	January 29	22	ND
	February 2	ND	ND
	February 9	ND	ND
	February 13	ND	ND
	February 21	ND	ND
	February 27	ND	ND
	March 5	ND	25
	March 22	25	ND
	April 4	29	26
	April 11	ND	ND
	April 16	ND	ND
Fairmont—Budd Lake	1961 November 21	87	26
	November 30	58	17
	December 6	70	34
	December 18	49	15
	December 28	45	42
	1962 January 3	50	30
	January 8	32	52
	January 15	32	43
	January 22	ND	ND
	January 29	32	ND
	February 5	ND	ND
	February 12	30	ND
	February 21	28	ND
	February 27	42	ND
	March 16	ND	ND
	April 4	50	38
	April 11	71	41
	April 16	40	ND
Fond du Lac—St. Louis River	1959 November 11	—	18
	December 16	—	18
	1960 May 11	—	9
	September 22	—	4
	October 27	—	9
	December 8	—	ND
Hallock—Two Rivers South Fork	1961 November 21	46	30
	November 30	26	23
	December 9	26	4
	December 14	21	14
	December 21	20	146
	December 27	17	3
Hallock—Con.	1962 January 3	26	20
	January 11	43	27
	January 18	46	19
	January 25	150	ND
	January 31	ND	ND
	February 8	ND	ND
	February 13	ND	ND
	February 21	ND	ND
	February 27	ND	ND
	March 5	ND	ND
	March 22	ND	ND
	April 4	54	ND
	April 16	42	ND
International Falls—Rainy River	1960 January 14	20	14
	February 15	16	6
	March 8	14	11
	April 6	10	11
	May 10	ND	16
	July 13	21	7
	August 29	44	ND
	September 7	4	11
	October 7	ND	ND
	November 10	18	9
	December 2	14	12
	1961 January 9	15	15
	May 22	16	33
	June 5	5	5
	June 3	18	22
	August 7	ND	17
	September 8	30	34
	October 5	38	27
	November 13	32	36
	December 11	24	4
	1962 January 3	12	17
	February 2	ND	ND
	March 5	ND	ND
	April 4	ND	ND
Minneapolis–Mississippi River	1959 September 2	47	20
	September 8	ND	20
	September 15	ND	ND
	September 22	ND	ND
	September 29	24	18
	October 6	19	7
	October 13	11	8
	October 27	17	10
	November 2	17	14
	November 9	12	13
	December 22	8	30
	December 28	ND	2
	1960 January 5	12	12
	January 12	7	6
	January 20	17	9
	January 26	14	12
	February 3	18	14
	February 8	12	16
	February 16	4	ND
	February 23	8	14
	March 2	8	18
	March 8	5	ND
	March 17	1	12
	March 23	25	ND
	March 29	17	4
	April 6	14	9
	April 11	20	20
	April 19	24	2
	April 28	12	4
	May 5	16	8
	May 10	44	11
	May 18	6	7
	1961 September 27	—	39
	October 2	—	33
	October 3	—	56
	October 4	—	66
	October 5	—	16
	October 9	—	15
	October 10	—	19

TABLE 1.—GROSS BETA CONCENTRATION IN MINNESOTA SURFACE WATERS—Continued
August 1959—April 1962

[Concentrations in $\mu\mu c$/liter]

Town and water source	Sampling date		Raw water	Treated water
Minneapolis—Con.		October 11	—	34
		October 13	—	7
		October 16	—	32
		October 17	—	70
		October 20	—	44
		October 25	—	27
		October 26	—	34
		October 27	—	28
		October 30	—	220
		November 1	—	26
		November 2	—	29
		November 3	—	22
		November 6	—	44
		November 8	—	100
		November 9	—	52
		November 15	—	40
		November 16	—	42
		November 17	—	36
		November 20	—	40
		November 22	—	24
		November 24	—	13
		November 28	—	37
		November 29	—	3
		December 1	—	9
		December 4	—	5
		December 6	—	7
		December 8	—	15
		December 13	—	12
		December 15	—	15
		December 18	—	17
		December 27	—	34
	1962	January 30	—	ND
		Feruary 6	—	ND
		February 27	—	ND
		March 6	—	ND
		March 7	—	ND
		March 8	—	ND
		April 12	—	ND
Saint Cloud—Mississippi River	1960	January 14	11	6
		February 23	17	11
		March 8	13	1
		May 10	ND	13
		June 27	22	29
		July 14	7	29
		August 29	33	14
		September 7	6	10
		October 11	31	4
		November 10	9	7
		December 1	18	13
	1961	January 10	18	13
		February 7	12	14
		March 13	9	10
		April 11	8	18
		May 22	8	4
		June 5	13	30
		July 3	6	1
		August 7	6	12
		September 8	60	44
		October 4	60	24
		November 4	85	44
		November 29	34	36
	1962	January 3	17	35
		January 31	25	ND
		February 13	ND	ND
		April 11	ND	ND
St. Paul—Vadnais Chain of Lakes	1959	September 2	ND	23
		September 10	24	20
		September 15	ND	ND
		September 22	1	24
		September 29	17	19
		October 6	20	15
		October 13	12	16
		October 19	16	16
		October 27	21	23
		November 2	30	16
		November 9	13	23
		November 18	20	15
		December 22	23	13
		December 30	14	ND
St. Paul—Con.	1960	January 12	12	18
		January 14	8	16
		January 20	16	5
		January 26	10	10
		February 3	8	17
		February 8	19	4
		February 16	14	15
		February 24	18	18
		March 2	17	18
		March 8	ND	ND
		March 17	7	ND
		March 23	20	8
		March 29	ND	ND
		April 6	15	10
		April 11	22	9
		April 19	10	4
		April 28	23	12
		May 5	16	12
		May 10	4	ND
		May 18	20	ND
		May 24	19	25
		June 3	20	18
		June 6	9	19
		June 13	13	13
		June 20	7	ND
		June 27	18	14
		July 5	4	22
		July 11	ND	ND
		August 1	22	13
		August 8	18	11
		August 15	13	13
		August 22	34	13
		August 29	26	18
		September 6	ND	16
		September 12	16	ND
		September 19	4	ND
		September 26	23	ND
		October 3	37	5
		October 10	19	ND
		October 17	11	16
		October 24	12	12
		October 31	12	12
		November 7	16	10
		November 14	3	2
		November 21	9	25
		November 28	10	6
		December 6	22	11
		December 13	16	8
		December 21	16	19
		December 22	13	ND
	1961	January 3	20	ND
		January 16	ND	2
		January 17	ND	13
		January 24	9	9
		January 31	9	11
		February 7	5	6
		February 16	24	6
		February 20	15	11
		February 28	20	5
		March 6	15	3
		March 13	14	6
		March 21	18	16
		March 28	22	1
		April 3	17	9
		April 11	24	11
		April 18	ND	10
		April 25	4	9
		May 2	ND	9
		May 11	29	27
		May 16	22	32
		May 23	45	ND
		May 31	ND	ND
		June 6	7	10
		June 13	2	7
		June 20	11	ND
		June 27	3	14
		July 5	10	17

TABLE 1.—GROSS BETA CONCENTRATIONS IN MINNESOTA SURFACE WATERS—Continued
August 1959–April 1962

[Concentrations in $\mu\mu c$/liter]

Town and water source	Sampling date	Raw water	Treated water
St. Paul—Con.	July 11	18	40
	July 18	24	39
	July 25	29	25
	August 1	11	10
	August 8	18	16
	August 15	19	21
	August 22	40	33
	August 29	30	24
	September 6	48	36
	September 12	34	22
	September 18	43	22
	September 26	52	78
	October 3	21	22
	October 10	24	21
	October 17	35	85
	October 24	7	38
	October 31	62	46
	November 7	36	29
	November 14	37	28
	November 21	28	34
St. Paul—Con.	November 28	46	37
	December 4	25	22
	December 11	27	34
	December 18	46	10
	December 26	33	34
	1962 January 2	64	29
	January 8	ND	ND
	January 15	34	20
	January 22	ND	ND
	January 29	ND	ND
	February 5	ND	ND
	February 12	ND	ND
	February 19	ND	ND
	February 27	ND	ND
	March 6	ND	ND
	March 22	27	25
	April 4	ND	ND
	April 11	ND	ND
	April 16	ND	ND

[a] Dash indicates no analysis performed.
[b] ND indicates beta activity not detectable.

TABLE 2—GROSS ALPHA CONCENTRATIONS IN MINNESOTA GROUND WATER

[Concentrations in $\mu\mu c$/liter]

District and sampling date	Geological formation	Number of locations	Maximum	Minimum	Average
I	Glacial drift (Pleistocene)	46	4.3	[a]ND	1.8
	Cretaceous sandstone	1	0.3	0.3	0.3
August 1961	Biwabik iron formation (Precambrian)	6	11.0	0.5	5.0
	Knife Lake slates (Precambrian)	1	3.7	3.7	3.7
	Keewatin greenstone (Precambrian)	1	1.9	1.9	1.9
II	Glacial drift (Pleistocene) or alluvium (Recent)	18	13	ND	1.6
	Sedimentary rocks				
	Devonian—Cedar Valley formation	2	31	ND	16
	Ordovician—Platteville, St. Peter, and Oneota formation	8	19	ND	5
December 1961	Cambrian—Jordan, and St. Lawrence formations	8	28	ND	8
	Cambrian—Franconia formation	4	21	ND	10
	Cambrian—Dresbach formation	9	20	ND	7
	Granite (Precambrian)	1	ND	ND	ND
III	Glacial drift (Pleistocene) or alluvium (Recent)	3	7.3	0.4	3.1
	Sedimentary rocks				
	Devonian—Cedar Valley formation	9	5.8	1.2	3.8
	Ordovician—Maquoketa and Galena formations	21	14.0	0.7	5.6
March 1960	Ordovician-Decorah, Platteville, Glenwood, and St. Peter formations	7	13.0	1.4	5.4
	Ordovician-Shakopee, Root Valley, and Oneota formations	.3	7.3	ND	2.0
	Cambrian-Jordan and St. Lawrence formations	23	15.0	0.7	5.2
	Cambrian-Franconia and Dresbach formations	16	32.0	1.7	10.6
IV	Glacial drift (Pleistocene)	15	3.9	ND	0.9
	Hinckley sandstone (Cambrian)	1	5.6	5.6	5.6
May 1961	Biwabik iron formation (Precambrian)	2	1.9	1.8	1.8
	Slates (Precambrian)	2	3.4	ND	1.7
	Sandstone (Precambrian)	1	ND	ND	ND
V	Glacial drift (Pleistocene) or alluvium (Recent)	49	34.0	ND	5.8
March 1961	Sioux quartzite (Precambrian)	5	11.7	5.4	7.6
	Cretaceous sandstone	10	10.0	ND	2.9
VI	Glacial drift (Pleistocene) or alluvium (Recent)	14	4.5	ND	1.3
	Sedimentary rocks				
	Ordovician-Shakopee and St. Peter formations	5	13.0	1.1	5.7
February 1961	Cambrian-Jordan formation	22	17.0	ND	4.3
	Cambrian-St. Lawrence formation	4	12.8	0.3	6.5
	Cambrian-Franconia and Dresbach formations	29	60.5	ND	7.2
	Cambrian-Hickley formation	3	90.0	0.3	30.8

[a] ND indicates alpha activity is not detectable. When averaging, ND is assumed to be equal to zero.

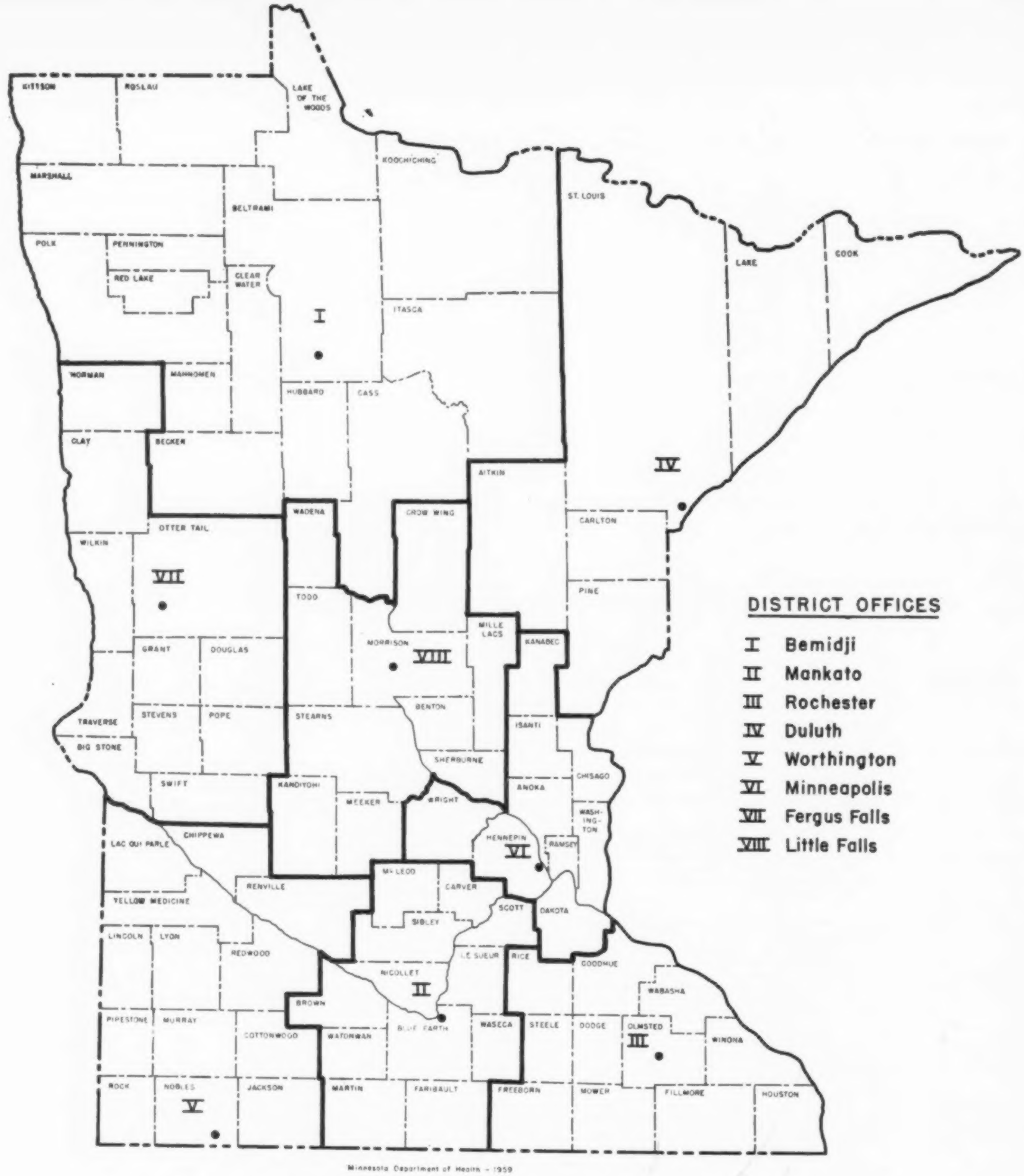

FIGURE 2.—SAMPLING DISTRICTS FOR MINNESOTA GROUND WATERS

SECTION V.—OTHER DATA

External Gamma Activity

Division of Radiological Health, Public Health Service

Daily measurements of external gamma radiation are made at stations of the Radiation Surveillance Network to assure detection of any substantial deviations from normal background levels. Portable Geiger-Mueller survey instruments are used to obtain measurements at three feet above the ground surface. May 1962 data reported in table 1 are characteristic of individual station observations which in recent years have defined the range of normal background values.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, MAY 1962

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Adak	Alaska	0.01	Minneapolis	Mass	0.01
Anchorage	Alaska	0.01	Jackson	Miss	0.01
Attu	Alaska	0.01	Pascagoula	Miss	[a]—
Cold Bay	Alaska	0.01	Jefferson	Mo	0.01
Fairbanks	Alaska	0.01	Helena	Mont	0.03
Juneau	Alaska	0.01	Lincoln	Nebr	0.01
Kodiak	Alaska	0.01	Concord	N. H	—
Nome	Alaska	0.01	Trenton	N. J	0.02
Point Barrow	Alaska	0.01	Santa Fe	N. Mex	0.03
St. Paul Island	Alaska	0.01	Albany	N. Y	0.03
Phoenix	Ariz	0.01	Buffalo	N. Y	0.01
Little Rock	Ark	0.01	New York	N. Y	—
Berkeley	Calif	0.01	Gastonia	N. C	0.02
Los Angeles	Calif	0.02	Bismarck	N. D	0.01
Denver	Colo	0.02	Columbus	Ohio	0.01
Dover	Del	0.01	Painesville	Ohio	0.01
Hartford	Conn	0.01	Oklahoma City	Okla	0.02
Washington	D. C	0.02	Ponca City	Okla	0.02
Jacksonville	Fla	0.01	Portland	Oreg	0.02
Miami	Fla	0.01	Harrisburg	Pa	0.01
Atlanta	Ga	0.03	San Juan	P. R	—
Agana	Guam	0.01	Providence	R. I	0.02
Honolulu	Hawaii	0.02	Columbia	S. C	0.02
Boise	Idaho	0.02	Pierre	S. D	0.02
Springfield	Ill	0.01	Nashville	Tenn	0.01
Indianapolis	Ind	0.02	Austin	Tex	0.01
Iowa City	Iowa	0.01	El Paso	Tex	0.02
Topeka	Kans	0.02	Salt Lake City	Utah	0.02
Frankfort	Ky	0.01	Richmond	Va	0.01
New Orleans	La	0.01	Barre	Vt	0.02
Augusta	Maine	0.02	Seattle	Wash	0.02
Presque Isle	Maine	0.02	Charleston	W. Va	0.02
Baltimore	Md	0.02	Madison	Wis	0.01
Lawrence	Mass	0.02	Cheyenne	Wyo	0.02
Winchester	Mass	0.01	Sundance	Wyo	—
Lansing	Mich	0.02			

[a] Dash indicates no data received.

Cesium–137 Levels In Man

Walter Reed Army Institute of Research, Washington, D.C., and U.S. Army Medical Research Unit, Landstuhl, Germany

Whole body counting facilities at the Walter Reed Army Institute of Research (WRAIR), Washington, D. C., and the Medical Research Unit, Landstuhl, Germany, continue the program for measuring the levels of cesium–137 in people.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
Third Quarter 1960	April 1961
Fourth Quarter 1960	April 1961
First Quarter 1961	July 1961
Second Quarter 1961	October 1961
Third Quarter 1961	January 1962
Fourth Quarter	April 1962

Table 1.—ASSAYS PERFORMED AT THE U. S. ARMY MEDICAL RESEARCH UNIT, LANDSTUHL, GERMANY

Date	Subjects residing in	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
December 1961	West Germany	109	34
January 1962	West Germany	73	33
February 1962	West Germany	299	28

Table 2.—ASSAYS PERFORMED AT THE WALTER REED ARMY INSTITUTE OF RESEARCH, FIRST QUARTER 1962

Geographic area	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
Europe	7	36
Far East	3	37
United States	104	28

Table 3.—ASSAYS OF INDIVIDUALS RESIDING WITHIN THE UNITED STATES PERFORMED AT WRAIR, FIRST QUARTER, 1962

State	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
Alabama	1	23
Arizona	1	32
California	5	33
Colorado	2	77
District of Columbia	23	26
Georgia	3	23
Illinois	5	30
Kentucky	2	20
Massachusetts	2	11
Maryland	10	25
Michigan	2	34
Minnesota	1	12
North Carolina	3	19
New Jersey	5	31
New York	7	26
Ohio	7	26
Oklahoma	1	31
Pennsylvania	8	11
South Dakota	1	0
Texas	4	27
Utah	1	30
Virginia	5	34
Vermont	2	29
Washington	1	18
Wisconsin	1	12
West Virginia	1	14

This report presents results from Germany for the period December 1961 through February 1962, and from Walter Reed for the first quarter of 1962. The Landstuhl data are listed by month in table 1 and the Walter Reed data are listed by geographic area in tables 2 and 3. The data of tables 1 and 2 are summarized in table 4.

Table 4.—SUMMARY OF TABLES 1 AND 2—FIRST QUARTER, 1962

Geographic area	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)	Percent MCP[a]
Europe	7	36	0.18
Far East	3	37	0.19
United States	104	28	0.14
West Germany	481	[b] 31	0.16

[a] *Radiological Health Data*, 2: 193–4 (April 1961).
[b] Values represent determinations for December 1961 through February 1962.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission receives from its contractors quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line no.	Radionuclide or mixture of radionuclides	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, Ra^{228}, Ra^{226}, Ra^{228}, Pa^{231}, and Th-nat are not present[a]	2,000	—
2	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present[a]	600	—
3	If Ra^{226}, Ra^{228} are not present[a]	100	—
4	Mixture of unidentified nuclides	10	0.04
5	If α emitters and Ac^{227} are not present[a]	—	1.0
6	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present[a]	—	10
7	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, and Bk^{249} are not present[a]	—	100
	Iodine-131 ($\beta - \gamma$)	[b]2,000	300
	Iodine-133 ($\beta - \gamma$)	7,000	1,000
10	Iodine-135 ($\beta - \gamma$)	20,000	4,000
11	Thorium-234 ($\beta - \gamma$)	20,000	100
12	Uranium-natural ($\alpha - \gamma$)	20,000	2

[a] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to recent FRC recommendations a group of nuclides may be considered not present if the ratio of each nuclide to its appropriate MPC is equal to or less than 1/10 and if the sum of these ratios for the group in question is equal to or less than 1/4.

[b] See FRC discussion on page 5-4.

Various summaries of the environmental radioactivity data for AEC installations have appeared in *Radiological Health Data* since November 1960. Summaries follow for Project Gnome, Atomics International (third and fourth quarters 1961), and Paducah Plant (third and fourth quarters 1961).

The measured concentration of a radionuclide in air and water may be compared with the Maximum Permissible Concentration (MPC) of that nuclide as recommended by the National Committee on Radiation Protection and Measurement (NCRP). For the environment near an AEC installation, the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards "Handbook 69." The MPC values applicable to the following reports are given in table 1.

The radiation protection guides for iodine–131 (Federal Radiation Council Report No. 2) indicate a concentration guide considerably lower (by a factor of 20) than the MPC for water given in table 1. Since the FRC's recommendation is based on the small thyroid of a young child, it may be implied that the MPC's for all iodine radio-isotopes should be reduced by the same factor.

In the following reports, nonspecific terms such as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic tests necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's reported by the laboratory.

PROJECT GNOME

Plowshare Program, Atomic Energy Commission
Carlsbad, New Mexico

On December 10, 1961, an underground nuclear detonation took place near Carlsbad, New Mexico (Project Gnome), as a part of the Plowshare Program. The tunnel did not seal completely and some radioactivity escaped, principally in the form of gases. The activity was carried by the winds to the north northeast. The following summaries of environmental contamination are based on the PHS report, "Off-Site Radiological Safety Report (Project Gnome)."

External Gamma

Of 285 film badges placed on persons and at localities around the test site, only 6 recorded a radiation exposure. The film badge showing the highest reading (165 milliroentgens) was located out-of-doors at Hudson Farm about 21

miles northwest of ground zero. The highest reading on any of the film badges worn by persons was 140 milliroentgens (also at Hudson Farms).

At the International Minerals and Chemical Corporation mine (12 miles north northwest of ground zero) the estimated out-of-doors exposure based on automatic recording survey meters was about 8 milliroentgens. There were about 74 miners present at the time of the passage of the radioactive air mass. Although the edge of the radioactive air mass passed over Artesia, New Mexico (45 miles northwest of ground zero), none of the film badges showed any exposure. The minimum detectable exposure for this type of film badge is about 30 milliroentgens.

Mine Surveys

Eight mines located within a 30 mile radius from the Gnome site were monitored for external beta-gamma levels before and after the shot event. The two sets of readings remained essentially the same.

Air Sampling

Of the 20 air samplers in operation only a few filters showed any appreciable increase of gross beta activity with the highest reading 160 $\mu\mu c/m^3$ for the $16\frac{3}{4}$ hour sampling period. The highest concentrations of iodine–131, iodine–133 and iodine–135 were 1.7 $\mu\mu c/m^3$, 18 $\mu\mu c/m^3$, and 3.5 $\mu\mu c/m^3$, respectively. All of the above were for a 16 hour collection period at the International Minerals and Chemical Corporation mine. All of the concentrations were well below permissible levels for the general population.

Water Sampling

Fourteen water sampling points were selected in the vicinity of the Gnome event. The The Off-Site Radiological Safety Report stated "No significant difference in radioactivity was found between the pre- and post-detonation water samples collected. Because of the possibility that radioactivity may enter the underground water strata over a long period of time, periodic water samples will continue to be taken during 1962 to continue the water surveillance activities in this area."

Milk Sampling

Milk samples were taken from eight producer dairies in the vicinity of the Gnome site. No increase in radioactivity was detected in the milk supplies from the Gnome event.

Animal Sampling

Five cattle were slaughtered prior to the Gnome event and five more about a month after the detonation for radiochemical analyses of their body tissues and organs. All the radioactive concentrations were found to be comparable for pre- and post-shot samples with the exception of one animal collected post-shot that had 1,100 $\mu\mu c/gm$ iodine–131 in the thyroid, and 0.14 $\mu\mu c/gm$ of cesium–137 in the muscle and 1.2 $\mu\mu c/gm$ of cesium–137 in the liver.

Surface Contamination

Although the radioactvity released from the tunnel was largely gaseous in form there was some particulate fallout in the local area. Some vehicles passing along Highways 31 and 128 (about 9 miles from ground zero) were contaminated, with the highest readings being about 200 milliroentgens per hour around the radiator and 150 milliroentgens per hour around the tires at about one hour after shot time. The highest reading inside of the cars was 15 milliroentgens per hour. Seven cars were washed with the result that the highest reading was 15 milliroentgens per hour around the radiator and essentially equal to background inside the car. Two individuals were found to have slight amounts of contamination (one on the hand and one in the hair), i.e., less than one milliroentgen per hour (beta plus gamma).

ATOMICS INTERNATIONAL
Third and Fourth Quarters 1961

Canoga Park, California

The Nuclear Development Field Laboratory (NDFL) and the World Headquarters Facility (WHF) are operated for AEC by Atomics International (AI), Canoga Park, California. The locations of the two facilities are shown in figure 1.

The NDFL facilities include a 20 megawatt SRE power reactor; several smaller experimental reactor facilities such as critical facilities, SNAP reactor, shield test facilities, and others; and extensive rolling and fuel fabrication operations. The major activities at the WHF are of the administrative type. However, a small amount of fuel fabrication is conducted at the site. For that reason the WHF area is included in the Atomics International environmental monitoring program.

Air Monitoring

Environmental air sampling is conducted continuously at the WHF and NDFL sites by automatic 24–hour step cycle air monitors. Airborne particulates are collected on a fixed filter tape which is moved, after each twenty-four hour period, to place the new sample beneath a thin window G. M. detector. At pre-set intervals, usually 20 minutes, the number of counts, observed by the scaler during the interval, is recorded.

It has been determined that for this type of instrument twice the counting rate after 18.6 hours decay minus the counting rate after 8 hours decay closely approximates the long-lived contribution. This counting rate can be

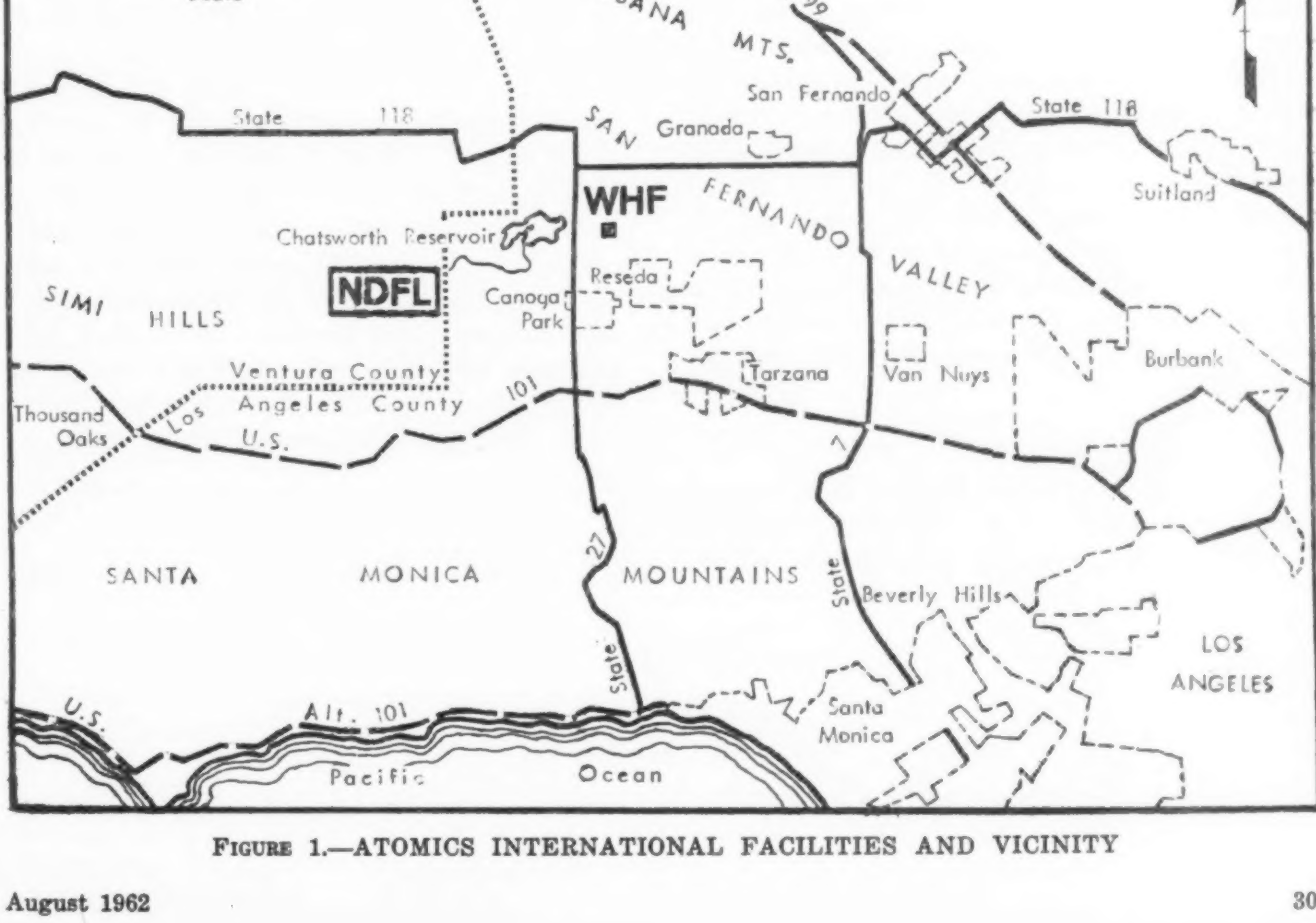

FIGURE 1.—ATOMICS INTERNATIONAL FACILITIES AND VICINITY

Table 2.—AVERAGE CONCENTRATIONS OF RADIOACTIVITY IN THE ENVIRONMENT AT THE ATOMICS INTERNATIONAL FACILITIES

Type of sample and minimum detection levels	Location	Type of analysis	Third quarter 1961		Fourth quarter 1961		Calendar year 1961	
			Number of samples	Average concentration	Number of samples	Average concentration	Number of samples	Average concentration
Air ($\beta-\gamma$ = 0.04 $\mu\mu c/m^3$)	WHF	$\beta-\gamma$	79	0.89	92	13	313	4.2
	NDFL	$\beta-\gamma$	79	0.89	55	10	176	3.6
Water (α = 0.05 $\mu\mu c$/liter) ($\beta-\gamma$ = 2.5 $\mu\mu c$/liter)	NDFL wells	α	6	0.13	6	0.06	24	0.08
		$\beta-\gamma$		<2.5		4.5		2.9
	Chatsworth Reservoir	α	15	0.47	13	0.63	43*	0.50*
		$\beta-\gamma$		6.0		19		11*
Soil (α = 0.24 $\mu\mu c$/gm) ($\beta-\gamma$ = 7 $\mu\mu c$/gm)	On-site	α	30	0.40	30	0.26	120	0.34
		$\beta-\gamma$		35.0		31		34
	Off-site	α	114	0.35	114	0.24	458	0.28
		$\beta-\gamma$		22.0		24		23
Vegetation (α = 0.08 $\mu\mu c$/gm ash) ($\beta-\gamma$ = 14 $\mu\mu c$/gm ash)	On-site	α	30	0.36	30	0.53	120	0.34
		$\beta-\gamma$		120		455		224
	Off-site	α	114	0.25	114	0.38	459	0.28
		$\beta-\gamma$		109		593		246

* Based on three quarters.

converted easily to the average long-lived airborne activity ($\mu\mu c/m^3$) during the sampling period. The minimum detection limit, which varies somewhat between instruments, is on the order of 0.04 $\mu\mu c/m^3$. The average concentrations of long-lived airborne beta emitters are shown in table 2.

When abnormally high activities are observed, the data are plotted to determine the presence of short-lived activities other than radon and thoron daughters. If fallout is suspected, samples are removed to the laboratory where their decay is observed for a period of several days to several weeks. If the activity decays as a function of $t^{-1.2}$, the data are extrapolated in order to find the date of origin. This date is then compared with the dates of announced nuclear detonations in order to demonstrate that the abnormal airborne activity was not caused by Atomics International operations.

Water Monitoring

Two water wells at the Nuclear Development Field Laboratory are sampled monthly. Monthly surface samples are collected at the Chatsworth Reservoir, owned by the Los Angeles City Department of Water and Power. The average water activity is shown in table 2.

Soil and Vegetation Sampling

Soil and vegetation are sampled monthly at 38 locations. Ten of these are within the boundaries of the Atomics International sites; the remaining 38 are within a ten-mile radius of the sites. Data for soil and vegetation are shown in table 2.

Surface soil types available for sampling range from decomposed granite to clay and sandy loam. Collected samples represent the top one-half inch layer of ground surface.

Vegetation samples obtained in the field at each station are of the same plant type wherever possible, and are generally sunflower or wild tobacco plant leaves. These plant types maintain an active rate of growth during the dry season, a characteristic uncommon to most other plant types indigenous to the area.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1960 and first and second quarters 1961	December 1961

PADUCAH PLANT
Third and Fourth Quarters 1961

Union Carbide Nuclear Company
Paducah, Kentucky

The Paducah Plant is a Government owned gaseous diffusion plant operated by Union Carbide Nuclear Company for the Atomic Energy Commission. The gaseous diffusion plant and the associated uranium hexafluoride manufacturing plant and uranium metal foundry process large quantities of relatively pure uranium compounds. The major sources of external penetrating radiation from such materials are the daughter-product isotopes of thorium and protactinium formed by alpha decay and subsequent beta decay of the parent uranium. These isotopes are concentrated in the ash produced during the fluorination process. The element uranium can be a physiological hazard only if it enters the body. The chemical toxicity of the uranium materials processed at the Paducah Plant overshadows any radiation danger from this element, making it a physiological risk comparable to lead, mercury, or other well-known heavy metals.

Uranium is a rather expensive material, and thus represents a great incentive to recover as much as is economically feasible. To protect the population and to maintain a wholesome relationship with neighboring communities and individuals, the air is exhausted through filters, and all effluent waters are discharged at extremely low concentrations of uranium.

Since no recovery process or filtering system is 100 percent efficient, an environmental monitoring program is used to evaluate the effectiveness of such measures. The Paducah Plant Environmental Monitoring Program consists

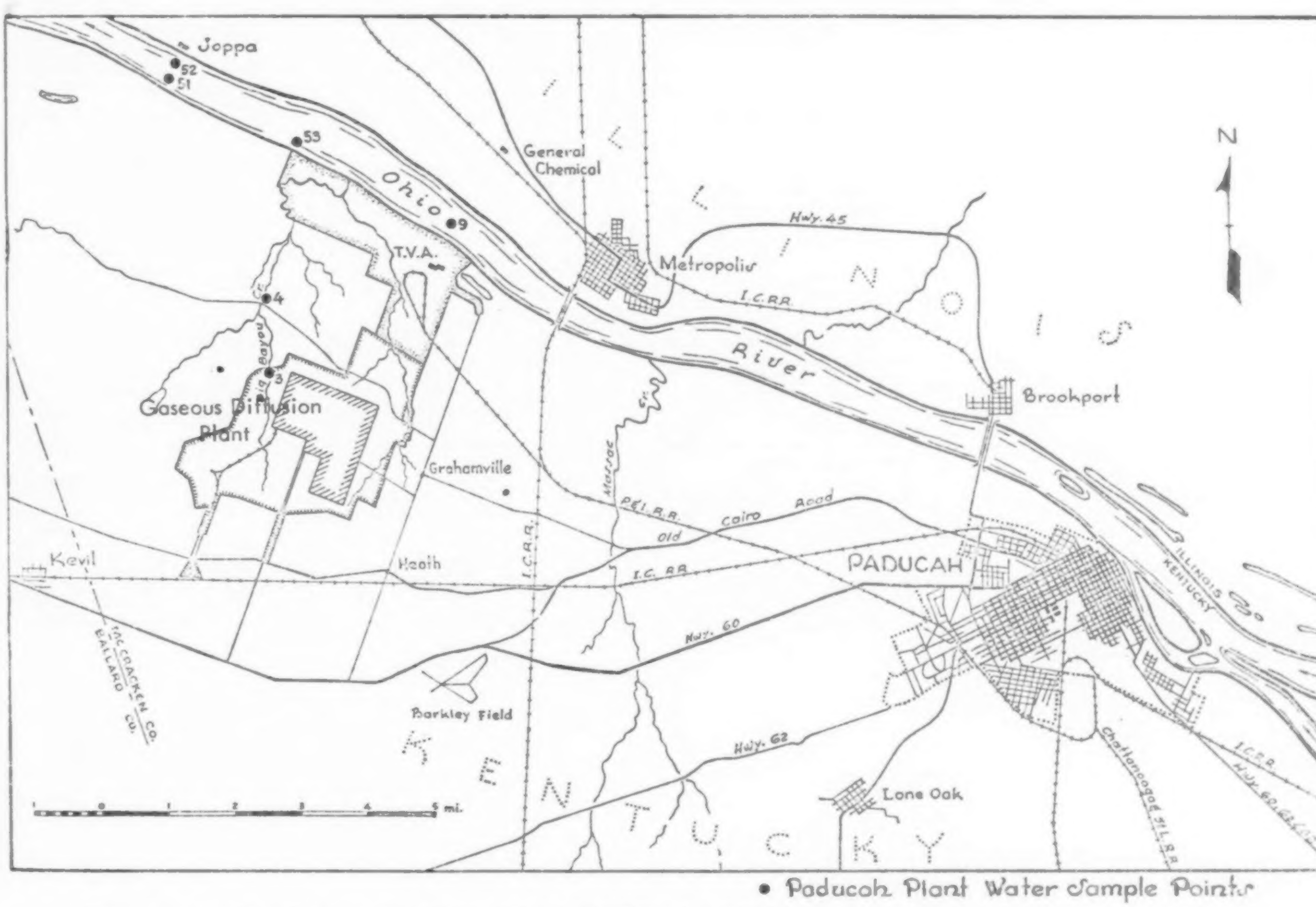

FIGURE 2.—WATER SAMPLING LOCATIONS, PADUCAH GASEOUS DIFFUSION PLANT

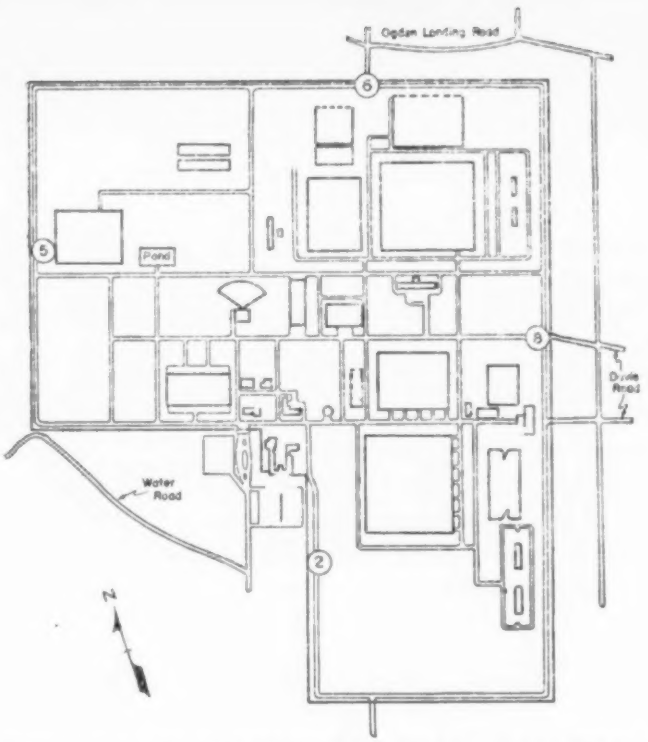

FIGURE 3.—AIR SAMPLING POSITIONS, PADUCAH GASEOUS DIFFUSION PLANT

of a continuing system for sampling air in four stations around the plant perimeter fence, and four off-site stations; and for sampling water at two locations in Big Bayou Creek, and four locations on the Ohio River as shown in figures 2 and 3. Tables 3 and 4 present air and water monitoring data.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1959 and first quarter 1960	December 1960
Second and third quarters 1960	March 1961
Fourth quarter 1960	July 1961
First and second quarters 1961	January 1962

TABLE 3.—RADIOACTIVITY IN THE PADUCAH PLANT ENVIRONMENT*

Sampling details		Third quarter 1961		Fourth quarter 1961		Calendar year 1961	
Type	Location & Frequency	Uranium	Beta	Uranium	Beta	Uranium	Beta
Air (μμc/m³)	At plant perimeter:						
Minimum detection level:	North (No. 6) weekly	0.19	9.3	0.17	3.3	0.13	4.4
U = 0.018	East (No. 8) weekly	0.12	6.5	0.095	3.7	0.068	2.8
beta = 0.075	South (No. 2) weekly	0.13	6.3	0.084	5.1	0.074	3.6
	West (No. 5) weekly	0.12	5.4	0.068	4.1	0.066	2.6
	Average	0.14	6.9	0.104	5.2	0.084	3.3
	One mile outside plant perimeter:						
	North weekly	0.10	3.4	0.092	3.6	0.072	2.2
	East weekly	0.12	3.5	0.068	6.9	0.069	2.3
	South weekly	0.12	5.0	0.097	4.2	0.073	3.2
	West weekly	0.12	3.5	0.084	6.0	0.073	2.4
	Average	0.12	3.8	0.085	4.0	0.072	2.5
Water (μμc/liter)	Big Bayou Creek:						
Minimum detection level:	No. 3 weekly	15	300	19	330	17	270
U = 1	No. 4 monthly	11	400	34	140	16	260
beta = 100	Ohio River:						
	No. 9	<1	100	<1	180	<1	190
	No. 51	<1	100	1.3	<100	<1	160
	No. 52	1	100	<1	<100	<1	150
	No. 53	<1	300	<1	<100	<1	170

* For MPC values see table 1, lines 11 and 12.

Survey of Radioactivity in Animal Feeds

Food and Drug Administration

A part of the continuing surveillance of radioactivity in foods by the Food and Drug Administration is concerned with the levels of strontium–90 in animal feeds. The samples are analyzed in a manner similar to food items, as indicated in Section II of this issue. Data on strontium–90 in animal foods appear in tables 1 and 2.

The leafy types of animal feeds show a higher concentration of strontium–90 than the other types. Alfalfa in particular demonstrates an increased strontium–90 concentration following resumption of U.S.S.R. nuclear testing. Also, alfalfa shows a higher strontium–90 concentration in the east zone than in the west harvest zone.*

Previous coverage in *Radiological Health Data:*

Period	*Issue*
1959	December 1960
1960	September 1961
1960 and 1961	December 1961
1960	April 1962

* See figure 1 in food section.

TABLE 1.—STRONTIUM-90 CONTENT OF VARIOUS ANIMAL FOODS

Animal food	Pre-test			Post-test		
	No. of samples	Mean (μμc/kg)	Standard deviation of mean	No. of samples	Mean (μμc/kg)	Standard deviation of mean
Alfalfa:						
West	2	52.5	12.7	5	176	36.
Central	3	137	63.5	1	303	—
East	—	—	—	2	354	0.00
Beet pulp:						
West	3	44.4	10.2	2	71.5	8.64
Central	2	87.5	39.4	1	76	—
East	—	—	—	—	—	—
Corn silage:						
West	—	—	—	—	—	—
Central	—	—	—	2	28.5	8.35
East	—	—	—	1	44	—
Cottonseed hull & seed:						
West	1	12	—	1	7.6	—
Central	1	3.1	—	—	—	—
East	2	42	5.91	—	—	—
Lespedeza:						
West	—	—	—	—	—	—
Central	—	—	—	—	—	—
East	3	394	99.0	2	658	241
Peanut hay:						
West	—	—	—	—	—	—
Central	—	—	—	—	—	—
East	—	—	—	2	727	102
Sorghum:						
West	—	—	—	2	41	5.46
Central	—	—	—	—	—	—
East	—	—	—	—	—	—
Sudan grass:						
West	—	—	—	—	—	—
Central	1	89	—	—	—	—
East	—	—	—	—	—	—

TABLE 2.—STRONTIUM-90 CONTENT OF VARIOUS ANIMAL FEEDS

Product	Origin			Harvest or collection date	Strontium-90 (μμc/kg)
	Harvest region	State or country	County		
Alfalfa	1	Calif.	San Bernardino	July 10, 1960	4.0
		Idaho	Jerome	Sept. 26, 1961	27.2*
			Jefferson	Oct. 26, 1961	20.7*
	2	Colo.	Larimer	Aug. 25, 1960	6.5
			Morgan	Nov. 9, 1961	16.1*
	3	Okla.	Kay	Aug. 7, 1960	1.8
			Choctaw	Aug. 23, 1961	23.4
	3	N. Mex.	Dona Ana	Sept. 22, 1961	5.2*
			San Juan	Sept. 25, 1961	18.9*
	5	Mich.	Lenawee	Aug. 10, 1961	15.8
	5	Wis.	St. Croix	Oct. 28, 1961	30.3*
	10	Va.	Bedford	Jan. 18, 1962	34.4*
	10	W. Va.	Jefferson	Jan. 5, 1962	36.5*
Beet Pulp	1	Calif.	Yolo	Aug. 17, 1961	2.4
	1	Idaho	Twin Falls	Oct. 9, 1961	6.1*
	2	Colo.	Logan	Feb. 9, 1961	5.4
			Weld	Oct. 9, 1961	8.2*
	2	Wyo.	Washakie	Jan. 18, 1961	5.5
	4	Minn.	Chippewa	Nov. 28, 1961	7.6*
	4	Nebr.	Buffalo	Oct. 17, 1960	12.7
	7	Ohio	Wood	Sept. 30, 1960	4.8
Corn silage	4	Minn.	Wright	Dec. 26, 1961	3.7*
	5	Wis.	Waupaca	Nov. 1, 1961	2.0*
	10	Va.	Roanoke	Feb. 14, 1962	4.4*
Cottonseed meal	1	Calif.	Tulare	Dec. 1, 1960	1.2
	3	N. Mex.	Chavez	Nov. 16, 1961	7.6*
	3	Tex.	Terry	Oct. 11, 1960	3.1
Hull	9	S. C.	Bamberg	Sept. 15, 1960	3.6
				Sept. 15, 1960	4.8
Lespedeza	9	N. C.	Wake	Jan. 17, 1961	44.7
				Jan. 24, 1962	89.9*
	10	Md.	Howard	Jan. 24, 1961	20.4
	10	Va.	Washington	Feb. 8, 1961	52.9
			Bedford	Jan. 18, 1962	41.7*
Peanut hay	10	Va.	Nansemond	Dec. 15, 1961	81.4*
			Dinwiddie	Feb. 6, 1962	63.9*
Sorghum	3	Ariz.	Yuma	Oct. 24, 1961	4.6*
	3	N. Mex.	Quay	Dec. 14, 1961	3.5*
Sudan grass	3	Okla.	Comanche	Aug. 23, 1961	8.9

* Denotes products harvested after September 15, 1961.

Reported Nuclear Detonations

July 1962

Since October 1961, summary information on all known nuclear detonations during the month preceding publication have been regularly reported in this section. The table below summarizes the tests conducted during July 1962.

Test number	Location	Date	Yield range*	Type of test
67	Nevada Test Site	July 6	1000 kiloton	Underground (peaceful application).
68	Nevada Test Site	July 7	Low	Slightly aboveground.
69	Johnston Island	July 9	Megaton	Atmospheric (high altitude).
70	Christmas Island	July 10	Intermediate	Atmospheric.
71	Nevada Test Site	July 11	Low	Underground (shallow depth).
72	Christmas Island	July 11	Low megaton	Atmospheric.
73	Nevada Test Site	July 13	Low	Underground.
74	Nevada Test Site	July 14	Low	Atmospheric.
75	Nevada Test Site	July 17	Low	Atmospheric.
76	Nevada Test Site	July 27	Low	Underground.

* Low yield range has been announced as meaning about a nominal (20 kiloton) yield; intermediate yield meaning the range between nominal and one megaton; and low megaton meaning more than one but less than 5 megatons.

UNITS AND EQUIVALENTS

For the convenience of the reader, a selected list of units and equivalents frequently used in *Radiological Health Data* (*RHD*) is presented below.

Symbol	Name of unit	Equivalents
cpm	count per minute	
dpm	disintegration per minute	
$\mu\mu c$	micromicrocurie	1 $\mu\mu c$ = 1 pc = 2.22 dpm
pc	picocurie	
mc/km^2	millicurie per square kilometer	1 mc/km^2 = 1000 $\mu\mu c/m^2$ = 2.59 mc/mi^2
mi^2	square mile	
m^2	square meter	
m^3	cubic meter	1 m^3 = 1000 liters
gm	gram	
kg	kilogram	1 kg = 1000 gm = 2.2 lbs
mm	millimeter	precipitation: $mm = \frac{\mu\mu c/m^2}{\mu\mu c/liter}$
mr/hr	milliroentgen per hour	
Mev	million electron volts	

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